Obesity

ITS CAUSE, CLASSIFICATION, AND CARE

by

E. PHILIP GELVIN, M.D., F.A.C.P.

Associate in Medicine, New York Medical College, Flower and Fifth Avenue Hospital, Physician-in-Charge Obesity Clinic, Metropolitan Hospital, New York

and

THOMAS H. McGAVACK, M.D., F.A.C.P.

Professor of Clinical Medicine, New York Medical College, Flower and Fifth Avenue Hospital, New York



A HOEBER-HARPER BOOK

OBESITY ITS CAUSE, CLASSIFICATION, AND CARE

Medical Book Department of Harper & Brothers
Printed in the United States of America

For information address Paul B Hoeber, Inc
Medical Book Department of Harper & Brothers,
49 East 33rd Street, New York 16, N Y

FIRST EDITION

Mfg

Library of Congress catalog card number 57-7162

Contents

PREFACE ix

1 Definition and Clinical Features 1

Measurements of Obesity—Height Weight Tables—Estimation of Body Fat—Direct Chemical Analysis—Skinfold Measurements—Densitometry—Dilution Tests Clinical Evaluation of Fatness—Incidence—Hazards—Morbidity—Mortality

2 Adipose Tissue 12

Cell Origin—Innervation—Blood Supply—Nature of Stored Fat—Source of Stored Fat

3 Intermediary Metabolism of Carbohydrates and Fats 16

Fats—Carbohydrates—Interrelationships of Lipid and Carbohydrate Metabolism

4 Lipogenesis and Fat Mobilization 22

Lipogenesis—Fat Mobilization

5 Classification of Obesity 26

6 The Normal Regulation of Intake of Food 33

Hunger and Appetite—Mechanisms of Regulation of Food Intake—Thermostatic Mechanism Theory—Glucostatic Mechanism Theory—Conclusions

7 Etiology Hereditary, Psychological, Nervous, and Dietary Factors 38

Heredity—Psychological Factors—The Hypothalamus—Dietary Factors

8 Etiology Metabolic Factors 48

Increased Efficiency of Digestion and Absorption—Nitrogen Exchange—Respiratory Quotient—Basal Metabolic Rate—Specific Dynamic Action—Rebound of Metabolism—Luxury Consumption—Ketosis—Physical Activity—Lipophilia

9 Etiology Endocrine Factors 59

Thyroid—Gonads—Pituitary—Adrenal—Pancreas—Summary

10 Obesity in Childhood 67

11 Management General Considerations 69

Psychological Factors in the Patient—Role of the Physician

12 Management Increasing Energy Expenditure 73

Exercise—Drugs

13 Management Decreasing Energy Intake (Diet) 78

Functions of a Diet—Factors Involved in Planning a Diet—High Protein Diet—Protein Powders—High Fat Diet—The Dietary Prescription—Dietary Modifications for Children—Presentation of Dietary Instructions to the Patient

14 Management Anorexigenic Agents 96

Amphetamine Preparations—Addiction to Amphetamines—Metamphetamine (Desoxphedrine)—Discussion and Use of Anorexigenic Agents

15 Management Endocrine Preparations 109

Thyroid—Anterior Pituitary—Posterior Pituitary—Sex Hormones—11 Oxycorticoids

16 Management Miscellaneous Medications, Physiotherapy, Surgery 113

Bulk—Vitamin Preparations—Belladonna Preparations—Dehydration—Combinations of Drugs—Massage—Surgery

17 Course and Follow Up 119

The Rate of Loss of Weight—Termination of Treatment—Return Visits—Unsatisfactory Loss of Weight—The Management of a Case—Types of Patients and the Results Obtained—Those with Strong Incentive—Children—Others—Results Obtained in an Average Group—Results of Successful Weight Reduction

BIBLIOGRAPHY 133

INDEX 141

Preface

In this book we have attempted to present a practical program for the management of obesity It stems from personal experience primarily at the Obesity Clinic at Metropolitan Hospital, New York. The Obesity Clinic was organized some ten years ago as a specialized unit in the Metabolism and Endocrine Clinic because we felt that centralizing the management of our overweight patients in one place would bring about better care, more intensive follow-up and improved results

Overweight is one of the major medical problems of our day Most clinicians see in their practice some patients who should reduce Many different types of diets have been advocated for the treatment of obesity Complex methods for calculating caloric requirements on an individual basis have been devised The resulting confusion has often been a deterrent to active treatment of the overweight patient Yet it is the family physician who is best qualified to identify and treat the obese individual, not reducing salons, food faddists, and the purveyors of patent medicines

Patients are overawed by long lists of foods and suggested substitutions They resent being forced to memorize tables of caloric values, they do not enjoy the necessity for detailed planning of each meal.

From the start, we wondered just how much individual-

ization of the dietary prescription was necessary We felt that if the diet could be standardized so that with only slight modification it could be used for most patients, the work of the physician would be greatly simplified

We realized that the diet should be composed of ordinary foods, easily available under most circumstances in order to encourage cooperation on the part of the patient The patient must not be required to perform intricate calculations of calories or to become involved in the detailed planning of menus However, some latitude of choice must be left to the individual Daily prescribed menus are impractical, inconvenient, and monotonous

Many drugs have been recommended as helpful in the management of obesity With the cooperation of several pharmaceutical companies, we were able to study the effects of some of the more commonly used medications under controlled conditions

The progress of the work at the clinic toward our objectives resulted in the development of a program which is simple yet effective Experience acquired in the clinic was applied to private patients and to a group of employees of a large industrial organization with even more gratifying results Our success with these methods led us to the thought of sharing our technics with others

Great advances in the knowledge of the basic chemistry and physiology of fat metabolism deposition, and mobilization have been made recently Most of these studies have been published in specialized journals not ordinarily read by most physicians We have attempted to describe those findings that we feel are basic to the understanding of the problem, have practical applications, or tend to dispel popular misconceptions The bibliography, consisting mainly of

references in the English language, and the use of review articles whenever possible can serve as a springboard for more detailed readings in this fascinating field

It is not our intention to present a basic text on the physiology of obesity or the science of dietetics and nutrition We have no panacea to offer, nothing sensational nor magical. We do feel that the program for the management of obesity as presented in these pages is safe, effective, and consistent with principles of good nutrition, yet simple for the physician to prescribe and convenient for the patient to observe



CHAPTER 1

Definition and Clinical Features

ANY INCREASE in weight above the ideal, unless caused by pregnancy, pathological skeletal overgrowth, or retention of fluid, such as is seen in certain cardiovascular, renal, hepatic, or endocrine diseases, is caused by the deposition of fat tissue Such an accumulation of adipose tissue beyond the range of normal for the individual constitutes obesity [35]

Obesity, then, depends upon an increase in the amount of *fat* tissue When the increased amount of fat tissue causes an increase in weight in excess of 10 per cent of the optimum weight of an individual, the clinical diagnosis of obesity is justified However, it is obvious that the optimum weight must be established before a 10 per cent increment can be ascertained. This has not been a very simple thing to do

MEASUREMENT OF OBESITY

Height Weight Tables

The most common tables in use are those based upon the Medico Actuarial Investigation which was published in 1912 [5] These consist of two tables, one for men and one for women, and give the average body weight of individuals

of different height and age They refer to measurements obtained from subjects as they were ordinarily dressed according to the fashion of about 1900

The reliability of these tables is open to serious question Was the group studied a representative section of the adult population? What do the words *ordinarily dressed* mean, and how do fashions of about 1900 compare with those of today? Height was determined with shoes on How much of a variable was introduced thereby? Also, these tables represented average weight, not optimum, showing a progressive increase with age Thus, the weight of the average man increased about twelve pounds between the ages of 25 and 50 However, experience has indicated that this age trend is not desirable from the standpoint of mortality [79] Maximum development and growth is completed at about the age of 30 Any significant continued increase of weight beyond that age, unless caused by factors mentioned above, is usually the result of the deposition of fat The decrease in activity with advancing age, coupled with the maintenance of eating habits of younger years by many individuals probably caused this average increase for the entire group

Recently, other tables have been prepared which give a range of desirable weights, at each inch of height, for different body builds—slight, medium, and heavy These tables make no distinction in relation to age, but apply to all persons over age 25 These tables also refer to measurements 'as ordinarily dressed" They are based upon measurements made upon policy holders with the Metropolitan Life Insurance Company (Tables 1 and 2) [79] However, The same criticisms regarding representativeness and definition of the term 'as ordinarily dressed" that were leveled

TABLE 1 DESIRABLE WEIGHTS FOR MEN, AGES 25 AND OVER

Height (with shoes)		*Weight in Pounds (as ordinarily dressed)*		
Feet	*Inches*	*Small Frame*	*Medium Frame*	*Large Frame*
5	2	116–125	124–133	131–142
5	3	119–128	127–136	133–144
5	4	122–132	130–140	137–149
5	5	126–136	134–144	141–153
5	6	129–139	137–147	145–157
5	7	133–143	141–151	149–162
5	8	136–147	145–156	153–166
5	9	140–151	149–160	157–170
5	10	144–155	153–164	161–175
5	11	148–159	157–168	165–180
6	0	152–164	161–173	169–185
6	1	157–169	166–178	174–190
6	2	163–175	171–184	179–196
6	3	168–180	176–189	184–202

SOURCE Metropolitan Life Insurance Co, Statistical Bureau, 1943

TABLE 2 DESIRABLE WEIGHTS FOR WOMEN AGES 25 AND OVER

Height (with shoes)		*Weight in Pounds (as ordinarily dressed)*		
Feet	*Inches*	*Small Frame*	*Medium Frame*	*Large Frame*
4	11	104–111	110–118	117–127
5	0	105–113	112–120	119–129
5	1	107–115	114–122	121–131
5	2	110–118	117–125	124–135
5	3	113–121	120–128	127–138
5	4	116–125	124–132	131–142
5	5	119–128	127–135	133–145
5	6	123–132	130–140	138–150
5	7	126–136	134–144	142–154
5	8	129–139	137–147	145–158
5	9	133–143	141–151	149–162
5	10	136–147	145–155	152–166
5	11	139 150	148–158	155–169

SOURCE Metropolitan Life Insurance Co, Statistical Bureau, 1943

at the older tables apply to these In addition, many of these examinations were performed in the field where the height and weight of the applicant were *estimated* and not measured The accuracy of many of these *estimations* is questionable

Finally, no criteria are given for the definition of the term "frame" This depends solely on the subjective impression of the examiner The desirable weight of a man whose height is 5 feet 10 inches could vary from 144 to 175 pounds, depending upon the opinion of the examiner as to the "frame" of the individual It has been interesting (and amusing) to observe how different physicians, depending upon their own weight, categorize individuals

Even a superficial examination of these standards shows errors The average line of a college football team consists of a group of young men somewhat under 6 feet tall, weighing 190 to 200 pounds According to these tables, these athletes would be considered overweight

The question has been raised as to whether we are at all justified in estimating fatness by measuring height and weight It has been demonstrated that heavy muscled athletes and laborers may be poor in fat, although the body weight is above normal as measured by height-weight tables Conversely, inactive individuals with subnormal muscle mass may be obese, *even though the tables indicate* they have a body weight which is normal for their height [22, 61]

The human body is composed of several major components which are metabolically distinct, and which may vary independently to a large extent (1) fat, which may represent as much as 70 per cent of the gross weight, (2) extracellular water, which may represent from 10 to 60 per cent

of the gross weight (3) cells or "active tissue" (4) bone mineral In an average "normal" man these components represent something like 15 23 58 and 4 per cent respectively of the total body weight [61] It has been estimated that frank obesity is present when the fat content of the organism reaches 30 per cent of the body weight [78]

Estimation of Body Fat

Direct Chemical Analysis

This method is perhaps the most accurate but since it presupposes that the subject will be sacrificed it is not applicable to clinical studies in the human being

Skinfold Measurements

This is a simple method and depends upon the estimation that about half the total body fat is superficial and therefore directly accessible for clinical examination [62] A rather rough estimate of fatness can be made by pinching the skin at various locations Refinements of this technic involve the use of special calipers or demonstration in soft tissue roentgenograms of the thickness of the fat layer at the sides of the x ray silhouette

This skinfold measurement method is not completely reliable The thickness of the subcutaneous fat layer at different sites varies with age and sex and from individual to individual It is also difficult to estimate the total body fat from the fraction in the subcutaneous deposits measured at a limited number of sites [60 62]

Densitometry

Human fat has a density of about 0 92 while the fat free portion of the body has a density of about 1 1 [62] This

fat free portion represents the average of the density of bones whose density is about 2 9, of cells whose density is about 1 2, and of extracellular fluids with a density of slightly over 1 0 The mineral content of bone represents only about 4 per cent of the total weight of the average adult, and the extracellular fluid content tends to be a rather constant fraction of the lean body mass Thus, if the density of the body is known the fat content may be calculated [9, 122] The density of the body can be measured by weighing it under water and making corrections for the residual air in the lungs, and the gases in the intestinal tract Inaccuracies in weighing under water, variations in the degree of hydration, and individual differences in the amount of bone mineral will introduce errors into the final results Although this procedure is not too difficult to carry out, it is still essentially a research laboratory study, and not readily adapted to routine clinical use

Dilution Tests

Since the total body water tends to represent a constant fraction of the lean body mass, its estimation provides a basis for the calculation of the lean body mass provided neither dehydration nor edema exists [50]

An intravenous injection of a nontoxic, stable, water soluble substance that penetrates all body tissues is made, and, after allowing time for its diffusion throughout all the water in the body, the concentration of this substance is measured in a sample of the blood serum Some of the test substances used include thiourea, sulfanilamide, urea, antipyrine, deuterium oxide, and tritium water The accuracy of this method is limited by variations in hydration It is also time-consuming and analytically difficult, and is not readily adaptable to ordinary clinical use

Clinical Evaluation of Fatness

Fortunately, in clinical practice the degree of accuracy claimed for the above methods is not required Variations of as much as 10 per cent of the desirable body weight are not excessive We have found the use of a combination of the latest height weight tables (Tables 1 and 2) and skinfold measurements to be a useful guide in determining satisfactory weight of subjects The tables afford a rough indication as to the degree of overweight Skin thickness judged over several sites, such as upper arm, chin, abdomen, lower chest in the axillary line region hips, and thighs offers helpful corroborative information

It must be emphasized that the tables serve merely as a guide If the physical examination does not reveal any excessive amount of subcutaneous fat, no further weight reduction is encouraged, no matter what the tables predict Conversely, if examination reveals excess subcutaneous fat, weight reduction is continued even though the individual falls within normal range according to these tables With a little practice and experience, surprisingly good guesses can be made as to the degree of overweight

Incidence

The incidence of obesity is difficult to estimate, because there is no sharp dividing line between normal weight and overweight Using the tables of the Metropolitan Life Insurance Company, Armstrong estimates that about 15 million persons in this country are 10 per cent overweight, and at least 5 million are 20 per cent or more above the normal [4] Another estimate is that 28 per cent of the population is overweight 10 per cent or more, and 12 per cent are at least 20 per cent overweight Thus, obesity represents prob-

ably the most common danger to the life and health of the adult population of this country

Hazards

Morbidity

Numerous studies have brought out the association of obesity with many serious physical impairments Abnormalities of the cardiovascular system are considerably more frequent in overweight individuals than in those of normal weight Thompson found that in the 35 to 44 year old age group, a diastolic blood pressure of 90 mm of mercury or over was found in 26 per cent of those classified as heavy build, 15 per cent of those of medium build and 9 per cent of those of light body build In older age groups, the incidence of hypertension was higher, but the differences according to body type persisted [*116*] Master, Dublin and Marks in a sample of 74 000 industrial workers, showed a steady progression in average blood pressure (systolic and diastolic) with *increase in body weight for all age groups* and for both sexes [75] In a study of a group of Army officers, it was found that sustained hypertension developed more than twice as frequently in the obese as it did in those of normal weight [67]

Wilens, in a study based upon autopsy material found that the incidence of advanced atherosclerosis was about three times as frequent in the obese as in those of poor nutritional status (20 per cent of obese, 6 7 per cent of those poorly nourished) [*127*] Coronary atherosclerosis was also more commonly observed in the overweight individual

Electrocardiographic abnormalities were found to exist in 15 per cent of men who were more than 25 per cent over-

weight as compared with 8 5 per cent of those of normal weight and 2 per cent of those of underweight [103]

Gallbladder disease is more frequent in the obese A study of the weight of insurance applicants with a history of gall

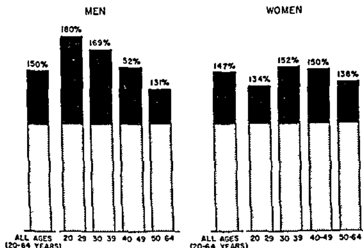


Fig 1 Per cent actual of expected deaths among men and women limited to substandard insurance because of overweight By age at issue of insurance Issues of 1925–1934 traced to policy anniversary in 1950 Death rates of standard risks in each sex = 100% (From Metropolitan Life Insurance Co , Statistical Bulletin, Vol 32, 1951)

stones revealed that 41 per cent of the men and 53 per cent of the women were overweight [33]

The increased incidence of diabetes in association with obesity has long been known Joslin found that 60 per cent of patients over age 40 were at least 20 per cent overweight at the time of onset of diabetes An additional 25 per cent were moderately overweight, making a total of 85 per cent

TABLE 3 PRINCIPAL CAUSES OF DEATH AMONG MEN AND WOMEN LIMITED TO SUBSTANDARD INSURANCE BECAUSE OF OVERWEIGHT
ATTAINED AGES 25 TO 74 YEARS ISSUES OF 1925 TO 1934
TRACED TO POLICY ANNIVERSARY IN 1950
(Death Rates of Standard Risks in Each Sex = 100%)

Cause of Death	*Men*		*Women*	
	No of Deaths	*% Actual of Expected Deaths*	*No of Deaths*	*% Actual of Expected Deaths*
Principal cardiovascular renal diseases	1 867	149	1 103	177
Organic heart disease diseases of the coronary arteries and angina pectoris	1 377	142	697	175
Cerebral hemorrhage	247	159	226	162
Chronic nephritis	*243*	*191*	*180*	*212*
Cancer—all forms	385	*97*	476	*100*
Leukemia and Hodgkin s disease	26	*100*	23	*110*
Diabetes mellitus	205	383	235	372
Tuberculosis—all forms	24	21	20	35
Pneumonia—all forms	98	*102*	78	*129*
Cirrhosis of the liver	96	249	32	*147*
Appendicitis	76	223	41	195
Biliary calculi (gallstones)	19	206	50	284
Ulcers of stomach and duodenum	30	67	10	*
Suicide	*63*	78	*23*	*75*
Accidents—total	177	*111*	74	135

* Deaths too few to warrant calculation of mortality ratio

Note Italics denote that the deviation from the Standard is not statistically significant

SOURCE Metropolitan Life Insurance Co Statistical Bulletin Vol 32 Oct 1951

who were overweight Only 5 per cent were underweight [44]

Osteoarthritis, especially it be appreciably more frequent ,36]

In a 641 p of

and Men an of

normal presentations, prolonged labor, and postpartum hemorrhage Operative intervention was required twice as frequently as in women of average weight Infant mortality was increased, as were puerperal maternal morbidity and mortality [76, 86]

In the presence of obesity, the surgical risk is high and embolic phenomena common [7, 36] Carcinoma of the uterus is apparently more frequent among obese than among normal women [52]

Mortality

Statistics of the Metropolitan Life Insurance Company indicate clearly that life expectancy is shortened in the obese (Fig 1) Contrary to the older belief that some degree of overweight is desirable in younger individuals, these findings indicate that the mortality ratio for overweight men was highest in the 20 to 29 age group For all ages the mortality among fat men was 150 per cent and for overweight women 147 per cent of that expected

The principal causes of death in the obese group are indicated in Table 3 Degenerative diseases of the heart, brain, and kidney, and diabetes were the most common factors in this increased mortality rate [32]

CHAPTER 2

Adipose Tissue

IN 1940, H G Wells entitled an article "Adipose Tissue, A Neglected Subject" [123] In the years following there has been considerable revival of interest in this subject Although a great deal is yet to be understood and explained, there have been tremendous advances in our knowledge of the anatomy, physiology, formation, and breakdown of fat tissue In the following three chapters, the results of a few of these investigations will be mentioned with the idea that some understanding of our present knowledge of the anatomy, chemistry, and physiology of adipose tissue may lead to a more rational approach to the therapy of obesity, and dispel the misconceptions advanced by faddists and cultists

CELL ORIGIN

Adipose tissue is not merely connective tissue loaded with fat and having no other function than that of fat storage It develops from special primitive fat cells, and has a specific structure distinct from the fibroblasts of connective tissue *This cell structure is more evident* when the stored fat is depleted [124]

The fatty depots form an organ system composed of individual lobules that develop chiefly during fetal life inde-

pendently of the degree of lipid storage in the cells In the development process these depots are intimately related to the vascular apparatus At one point during fetal life there is beginning differentiation of hitherto undifferentiated connective tissue around the blood vessels At first the immature fat cell cannot be distinguished from other connective tissue cells Later however the young fat cells take up lipid as they lie alongside the capillaries of a thick network of blood vessels

The reaction to vital staining helps distinguish developing adipose tissue from other mesodermal derivatives When newborn rats were injected with trypan blue and trypan red, weight and growth were retarded but the development of adipose tissue was not disturbed On the other hand following the administration of lithium carmine the primitive fat cells were checked but the blood vessels and connective tissue flourished These studies lend additional evidence to the view that adipose tissue is not lipid bearing connective tissue [95]

INNERVATION

An abundant network of nerves is found in fat tissue the larger units being in the connective tissue septa which subdivide the adipose tissue into lobes and lobules. The nerves are essential because they regulate the functional activity of the adipose tissue

Growth of the fat tissue is apparently controlled by efferent fibers of the autonomic nervous system which run to the periphery together with branches of the spinal nerves Increased storage of lipid follows nerve resection Whether this reaction is effected through direct nervous regulation of the blood vessels or by the production of acetylcholine-

CHAPTER 3

Intermediary Metabolism of Fats and Carbohydrates

Fats

INGESTED FATS are not stored directly, but are first metabolized to 2 carbon units and rebuilt into fatty acids for storage A brief review of the intermediary metabolism of fats may assist in the understanding of some of the processes involved in lipogenesis

The Knoop β oxidation theory, formulated in 1904, was the one accepted for many years This postulated a successive splitting at the β carbon atom of the long fatty acid chain, leaving a 4 carbon molecule which was converted to acetoacetic acid, β hydroxybutyric acid, and ultimately, to *acetone These make up the so called "ketone bodies" [63]* However, when the amount of acetone was calculated, it was discovered that an impossible amount of fat must have been metabolized to have formed the quantity of acetone that was found The acetone production was far in excess of that expected from successive β oxidations Thus, the β oxidation theory became untenable as the sole mechanism

In 1916, Hurtley proposed the hypothesis that the fatty acid was attacked at alternate carbon atoms simultaneously along the entire carbon chain [55] This hypothesis was

supported by the studies of Jowett and Quastel in 1935 [58] Similar results were reported by Stadie in 1940 and 1941 [105, 106] He postulated a multiple alternate oxidation mechanism and a splitting of the long chain at alternate β carbon atoms

Although this concept accounted for the formation of the relatively large amount of ketone bodies found several other questions remained unanswered In support of the successive β-oxidation theory, degradation products of the long-chain fatty acids i e, shorter chain fatty acids had been identified The presence of these degradation products could not be explained on the basis of the multiple alternate oxidation theory It was also difficult to explain why the splitting should occur regularly at alternate β carbon atoms

MacKay and his co-workers in 1940 offered another concept of the intermediary metabolism of fatty acids [72, 73] They accepted the β-oxidation theory of the successive formation of a shorter chain fatty acid and a molecule of acetic acid As this degradation process continued two molecules of acetic acid condensed to form acetoacetic acid and the other ketone bodies This hypothesis explained both the amount of ketone bodies formed and the identification of shorter chain fatty acids MacKay found that when acetic acid was fed to phlorhizinized dogs or fasting rats there was a marked rise in the excretion of acetone bodies demonstrating that the animal organism can synthesize ketone bodies from acetic acid [69]

It is likely that perhaps other reactions are involved in the metabolic degradation of long-chain fatty acids At the present state of our knowledge, the β-oxidation multiple condensation theory appears to offer the best explanation for most of the observed phenomena

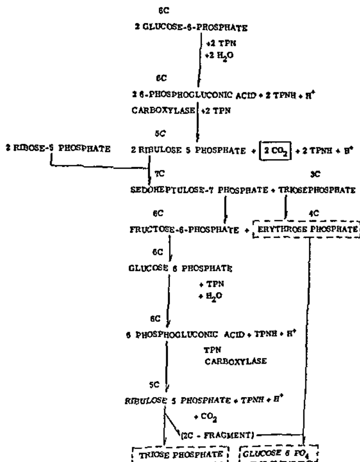


Fig. 3. The hexosemonophosphate shunt.

A schematic illustration of the intermediary metabolism of carbohydrates and fats and their interrelationship is presented in Figure 2.

Another pathway has recently been described It is called the "Hexosemonophosphate Shunt," or "Glucose Shunt" (Fig 3) By this mechanism 2-carbon fragments may again be synthesized to carbohydrate and not fat [96]

Carbohydrate is a normal precursor and the chief source of stored fat Animals on a fat free diet deposit fat in their tissues About 10 to 15 per cent of C^{14} labeled glucose fed to rats on a fat free diet was recovered as fatty acids [*11*]

The metabolism of carbohydrate supplies energy for building fatty acids from 2-carbon units Variations in carbohydrate metabolism will affect this formation of fatty acids Fat metabolism is subject to the control of hormones which exert their primary effect on carbohydrate metabolism

Two carbon units are produced in the metabolism of fats and carbohydrates At this stage, their metabolism is identical The citric acid cycle which effects the oxidation of 2 carbon units to CO_2 and water is the mechanism of both fat and carbohydrate oxidation [*11*]

CHAPTER 4

Lipogenesis and Fat Mobilization

THE CONVERSION of carbohydrates to fats has been known for many years Although some of the intermediate meta bolic processes have been identified, knowledge in this field is still relatively scanty

LIPOGENESIS

It is probable that only those substances capable of being degraded biologically to 2-carbon fragments can be synthesized *into long chain fatty acids It has been demon* strated that the carbon atoms of glucose, lactate, pyruvate, acetone, acetaldehyde, and acetic acid can be synthesized *into fatty acids The active 2 carbon unit is probably acetyl* Co A It is apparent that carbohydrate must undergo glycolysis before it can be utilized for fatty acid synthesis [47]

Acetyl Co A can be oxidized to CO_2 *and water, or be* synthesized to cholesterol, fatty acids, or ketone bodies, (Fig 2) Which of these occurs depends to a great extent upon hormonal and nutritional factors

Liver slices of normal rats can readily convert acetate to fatty acids This is not true of liver slices obtained from alloxan diabetic, fasting, or depancreatectomized rats The same results prevail whether acetate or glucose is used.

Although the addition of insulin to liver slices of normal animals stimulates the synthesis of fatty acids no *in vitro* effect can be demonstrated with liver slices of diabetic animals [47] However lipogenesis in liver slices of fasting rats can be stimulated by the addition of large amounts of glucose, or even more effectively glucose plus insulin [6]

Liver slices obtained from cats which have been pancreatectomized can convert labeled acetate into fat at a normal rate The addition of insulin accelerates this reaction while the administration of a purified growth hormone inhibits lipogenesis [47]

The oxidation of fatty acids is unimpeded or even accelerated in experimental diabetes C-labeled fatty acids are readily converted by such slices to acetoacetate The fasting state is also characterized by an accelerated hepatic oxidation of fatty acids and increased ketogenesis It is apparent that under these conditions there must be an abundance of 2-carbon units formed

It has been demonstrated that the oxidation of lactate and the decarboxylation of pyruvate proceeds in the diabetic state thus indicating that the glycolytic and oxidative enzymes are intact Since liver slices of fasted rats can oxidize acetate it appears that the activation of acetate is not impaired in such animals

It would appear then that for coupling of active 2-carbon units to form fatty acids an acetate activating system alone is inadequate It is likely that energy derived from glycolysis is necessary to drive these reactions in the direction of synthesis A common feature of diabetes and the fasting state is a diminished availability of intracellular substrates for glycolysis [47]

Glycolysis is accelerated by insulin probably by means of

a stimulating effect upon hexokinase activity The exact way in which the effects of insulin are brought about is not known The Coris postulated that insulin influences the rate of hexokinase activity by overcoming the inhibitory effect of a pituitary factor [93] *More recently, Levine has suggested that insulin exerts its effect by accelerating the permeation of glucose into the cell, and its metabolic effects are secondary to its entry into the cell* No effect upon the hexokinase system by insulin was found in the absence of cells [66]

No matter which explanation is correct, the diabetic and fasting states are characterized by an accumulation of 2 carbon fragments in the liver If their condensation to fatty acids is blocked there is a greater diversion of these 2 carbon units to acetoacetate, thus explaining the ketosis of diabetes and fasting Since the direct conversion of acetoacetate to cholesterol has been observed, the accumulation of acetoacetate could result in the accelerated formation of cholesterol observed in diabetes

Fat Mobilization

A striking increase in total liver lipids was found to follow the administration of small amounts of purified growth hormones [87, 121] Choline and other lipotropic agents did not influence this response to the fat mobilizing factor [87] Payne studied various types of anterior pituitary hormones in an attempt to establish whether the fat mobilizing factor was a function of one of the known anterior pituitary hormones, or distinct from them He studied the effects of the growth, thyrotropic, adrenotropic, lactogenic, follicle stimulating, and luteinizing hormones All these preparations showed some activity, though their potency varied [87]

Adrenalectomy completely inhibited this response The administration of cortisone restored it The effect of desoxycorticosterone was variable The administration of cortisone alone to adrenalectomized or intact animals had no effect upon the fat content of the liver

Neither thyroidectomy nor thiouracil, thyroxine, nor posterior pituitary hormones were able to induce fatty infiltration of the liver

It was thus concluded that neither the adrenotropic nor the thyrotropic hormone was the fat mobilizing factor Likewise, the inability to correlate the fat mobilizing factor with the potency of any of the other better known tropic hormones indicated that it is distinct from them

There are apparently at least two hormonal factors involved in fat mobilization an anterior pituitary factor and an adrenocortical factor [87]

Levin and Farber postulated that the pituitary factor *triggers* the reaction This triggering is not mediated by the adrenal cortex. The adrenal cortical hormones act directly on the fat tissue presumably on the enzyme systems It conditions the tissue thus rendering it responsive to the triggering factor which sets off the release of fat from the depots [65]

Two-carbon units are produced in the metabolism of fats and carbohydrates At this stage, their metabolism is identical The citric acid cycle which effects the oxidation of 2 carbon units to CO_2 and water is a mechanism of both fat and carbohydrate oxidation

CHAPTER 5

Classification of Obesity

TO BE of value any classification of disease must guide us to therapeutic procedures From this standpoint, there has thus far been no satisfactory classification of the obesities The common division into endogeneous and exogeneous, or into endocrine and nonendocrine, has, as far as we can determine, served no useful purpose Indeed, by definition, it is possible to place all obesities in the endogeneous class, or in the exogeneous class as one may desire For example, all overweight is exogeneous in the sense that the individual consumes more calories than he needs to maintain a normal weight Such an explanation fails to take into account any underlying factors which predetermine his needs or the reasons why he maintains an energy intake which is greater than his output At the other extreme, one may speak of all overweight as endogeneous, in that the individual ingests more food than he requires because of some inward compulsion or disease On this basis, on the one hand the cause of the fat may be found in a poorly adjusted personality which finds escape from reality in the pleasant pastime of eating, or on the other hand, the overweight may represent a severe glandular dyscrasia Between and including these two extremes lie many categories which will enable us to

place all subjects with obesity in the endogeneous class should we so desire

The ideal classification of obesity would be one based upon etiology In experimental physiology, one may speak of *hypothalamic obesity, gold thioglucose obesity,* or *hereditary obesity* [78] However, such an etiological classification of obesity is still of no practical clinical value in the present state of our knowledge The difficulties inherent in such a classification will be discussed further in the chapters dealing with the etiology of obesity

Another classification of obesity is essentially descriptive In this connection it should be emphasized that fat may be commonly distributed in one of four ways (1) about the head, neck, and upper body, an accentuation of the masculine configuration, and in more extreme forms often alluded to as the bullfrog or buffalo type, (2) about the lower abdomen, hips, and thighs, an accentuation of the feminine configuration, and in its extreme form resembling or corresponding to familial lipodystrophy, (3) in a girdle fashion with so-called "rolls" of fat about the chin, the axillae, the bust, the abdomen, the hips, the thighs, and, in extreme forms, also about the knees In this form, the overall height of the individual may be short, and the hands and feet relatively small and (4) generalized obesity, in which the entire body and extremities share rather evenly in the distribution of fat

The essential types, as summarized by LeRay, are as follows [61]

1 Android type, where the obesity is concentrated on the upper half of the body and, secondarily, on the abdomen

2 Gynoid type, where the fat is found predominantly at the level of the hips and lower half of the body

3 Endocrine type, characterized by the coexistence of recognized endocrine disorders The endocrine disorder is not necessarily the cause of the obesity, but may denote two manifestations of an underlying common etiology

The following classification of overweight has some etiological implications and simultaneously affords us at least a partial key to therapeutic procedures (Table 4) As

TABLE 4 TYPES OF OBESITY IN RELATION TO THEIR ORIGIN

- I Nervous Obesity
  - Hypothalamic
- II Endocrine Obesity
  - A Hypothyroid (?)
  - B Adrenal
  - C Ovarian
  - D Pituito-hypothalamic (?)
- III "Hereditary" or Familial Obesity (?)
- IV Habit Obesity

is true in most classifications, the rubrics in this one overlap each other to a greater or lesser extent For instance, the nervous or hypothalamic type of obesity might well include many cases of "habit obesity," where an abnormal appetite or lack of normal satiety is associated with or arises from disturbed nervous pathways The familial type of obesity may represent habitually abnormal eating customs within the confines of a single group of individuals On the other hand, it may indicate an inborn type of bodily build with which fat is unusually or abnormally distributed It is not uncommon, for instance, to find *all* of the men of a *single* family with exceptionally wide pelves, and abnormally heavy hips and thighs However, *maleness* is not disturbed in any of its essential characteristics By the same token, in some families, there is a tendency for the men to show an

increased distribution of fat about the head, neck, and shoulders, and for the women to display evidence of masculine configuration with relatively broad shoulders and narrow hips This we have termed the "adrenal type" of obesity, but it might just as easily have been included as a subgroup of the familial or hereditary form

It is not difficult to see that every arrangement of the obesities has its shortcomings Our own classification has proven of some use to us in selecting and directing therapy, it has no further justification At this point, it should be made clear that medicines will not substitute for the basic role which diet must play in the management of *all* obesities Nevertheless, we are convinced that the judicious and well indicated use of drugs in selected cases is of tremendous help in carrying out the dietary regimen and in reversing the underlying physiological disturbances which have led to the deposition of unwanted fat

In the hypothalamic, or nervous, group of patients we include all cases of Frohlich's disease and Frohlich's syndrome, some of the children with so called "adolescent obesity," and a majority of the individuals with a girdle type of obesity whether they do or do not show the rather delicate features and small hands and feet commonly associated with such a distribution of fat For the purposes of therapy it seems that we must also consider here those individuals, particularly women, who periodically lose and gain weight rapidly in relation to episodes of water retention and diuresis, and in whom such phenomena are associated with moderate to marked overweight These people appear to be subject to a considerable degree of emotional and autonomic nervous system lability, which may initiate or at least be associated with abnormal impulses arising in

the hypothalamic nuclei that regulate appetite and/or the storage of fat To carry this thought one step further, it is difficult to say just how often the excessive ingestion of food in people of normal weight has its origin in mental or emotional disturbances which subject the hypothalamic centers, and through them probably the pituitary, to stimuli capable of altering metabolic balances and of favoring the deposition of adipose tissue In other words, we include in this hypothalamic group of cases, some, if not all, of the individuals who have established faulty eating habits not connected with the familial pattern of food consumption into which they were born

Hypothyroid obesity has been included in our classification with a question mark, because it would appear that underfunction of the thyroid per se does not lead to obesity A slight increase in weight, rarely greater than five per cent, is present as a result of myxedema While the lowered metabolism undoubtedly could favor the deposition of adipose as well as myxedematous tissue, it appears that appetite is lowered as the hypothyroid state appears Thus a satisfactory balance between energy intake and outgo is maintained *Rarely does appetite stay at the previous level, in* such instances obesity may result, which will respond to specific medication with thyroid hormone

Obesity in association with the adrenal is due to an overactivity of the cells of the adrenal cortex, and is seen in cases of Cushing's syndrome This is a rare cause of obesity It should be treated specifically by control of the hyperfunction which induced it

It is not easy to explain the so-called "ovarian type" of obesity in which the deposition of fat is chiefly if not exclusively confined to the lower abdomen, hips, and thighs

So-called "familial lipodystrophy" and closely allied conditions probably should be included in this category of ovarian obesity The *middle-age spread* of the menopausal woman is the chief clinical example of so called "ovarian obesity" Hence in the minds of most individuals the condition is believed to be due to a diminution in or cessation of ovarian activity If this is true it seems strange that the feeding of ovarian hormone tends to exaggerate the condition Furthermore if decreased ovarian activity were the sole factor involved it is surprising that individuals with ovarian agenesis not only do not show this type of body build but on the contrary are rather short stocky individuals with relatively broad shoulders and narrow hips

It seems to us doubtful that a disturbance of the pituitary gland can cause obesity No syndrome has as yet been described in which either underfunction or overfunction solely of this gland or of any part of it has led to obesity The majority of the cases in which obesity has been ascribed to the hypophysis have actually been instances of hypothalamic obesity However without any conclusive evidence not only Frohlich s syndrome but also such conditions as the Lawrence Moon Biedl syndrome Dercum s disease and the Morgagni Morel syndrome have been ascribed to or believed to be associated with lesions in this gland It seems better to recognize the endocrine disturbances if any as secondary to the nervous dysfunction As far as the several diseases just mentioned are concerned congenital and hereditary factors may play a major role The pituitary certainly does not

In the hereditary congenital or familial causes of obesity we might well consider the Lawrence Moon Biedl syndrome Morgagni Stewart Morel s disease and similar prob-

the hypothalamic nuclei that regulate appetite and/or the storage of fat To carry this thought one step further, it is difficult to say just how often the excessive ingestion of food in people of normal weight has its origin in mental or emotional disturbances which subject the hypothalamic centers and through them probably the pituitary, to stimuli capable of altering metabolic balances and of favoring the deposition of adipose tissue In other words, we include in this hypothalamic group of cases, some, if not all, of the individuals who have established faulty eating habits not connected with the familial pattern of food consumption into which they were born

Hypothyroid obesity has been included in our classification with a question mark, because it would appear that underfunction of the thyroid per se does not lead to obesity A slight increase in weight, rarely greater than five per cent, is present as a result of myxedema While the lowered metabolism undoubtedly could favor the deposition of adipose as well as myxedematous tissue, it appears that appetite is lowered as the hypothyroid state appears Thus a satisfactory balance between energy intake and outgo is maintained Rarely does appetite stay at the previous level, in such instances obesity may result, which will respond to specific medication with thyroid hormone

Obesity in association with the adrenal is due to an overactivity of the cells of the adrenal cortex, and is seen in cases of Cushing's syndrome This is a rare cause of obesity It should be treated specifically by control of the hyperfunction which induced it

It is not easy to explain the so called "ovarian type" of obesity in which the deposition of fat is chiefly if not exclusively confined to the lower abdomen, hips, and thighs

So called "familial lipodystrophy" and closely allied conditions probably should be included in this category of ovarian obesity The *middle age spread* of the menopausal woman is the chief clinical example of so called "ovarian obesity" Hence, in the minds of most individuals, the condition is believed to be due to a diminution in or cessation of ovarian activity If this is true, it seems strange that the feeding of ovarian hormone tends to exaggerate the condition Furthermore, if decreased ovarian activity were the sole factor involved, it is surprising that individuals with ovarian agenesis not only do not show this type of body build, but on the contrary are rather short, stocky individuals with relatively broad shoulders and narrow hips

It seems to us doubtful that a disturbance of the pituitary gland can cause obesity No syndrome has as yet been described in which either underfunction or overfunction solely of this gland or of any part of it has led to obesity The majority of the cases in which obesity has been ascribed to the hypophysis have actually been instances of hypothalamic obesity However without any conclusive evidence, not only Frohlich's syndrome but also such conditions as the Lawrence-Moon Biedl syndrome, Dercum's disease, and the Morgagni Morel syndrome have been ascribed to or believed to be associated with lesions in this gland It seems better to recognize the endocrine disturbances, if any, as secondary to the nervous dysfunction As far as the several diseases just mentioned are concerned, congenital and hereditary factors may play a major role The pituitary certainly does not

In the hereditary congenital or familial causes of obesity we might well consider the Lawrence-Moon-Biedl syndrome, Morgagni Stewart-Morel s disease, and similar prob-

lems as developmental disturbances For most of these conditions, no satisfactory or specific therapeutic regimen exists

Habit obesity has already been discussed at some length ✓One of us leans to the view that most of the cases of habit obesity have developed as a result of abnormal nervous and mental stimuli while the other looks upon this condition as purely exogeneous in origin, the result of following a pattern laid down by others as a simple mechanism for escape from reality In any event, abnormal appetite exists, and must have some mediation via glandular or nervous structures within the body, irrespective of the extraneous forces which may have played a role in bringing it about

In summary, no classification of obesity is wholly satisfactory Justification for the present one resides chiefly in the fact that it affords some useful guides to the selection and pursuit of therapeutic procedures

CHAPTER 6

The Normal Regulation of Intake of Food

Hunger and Appetite

Hunger and appetite are terms used to describe sensations leading to the ingestion of food Hunger is an unpleasant sensation described as an empty feeling in the epigastrium Cannon and Washburn have shown that sensations of *hunger pains* coincide with waves of contraction of the empty stomach. Appetite is a pleasant desire for food It is based upon previous acquaintance with food, impressions of sight and smell, and is conditioned by habit and training

Hunger and appetite are interdependent in regulating the intake of food An individual may eat in spite of the absence of hunger, for example, the partaking of a rich dessert following a sumptuous meal Conversely, unpleasant sensations can completely eliminate the desire for food, although the individual was hungry prior to exposure to the unpleasant stimulus Although the two probably differ physiologically, an exact differentiation between them is difficult However, such differentiation is unnecessary clinically Both result in eating, and it is the excessive intake of food that results in obesity

Mechanisms of Regulation of Food Intake

Many theories have been advanced to explain the regulation of intake of food energy Early concepts held that the taking of food was the result of (1) stimulation of afferent nerves by some local changes in the tissues, mainly in the stomach, (2) a hunger center in the brain was sensitive to a starvation state of the blood, and (3) a hunger center in the brain was stimulated directly by a hunger state of the blood and also indirectly by afferent impulses from all organs of the body [78]

After it was demonstrated that hunger sensations coincided with contractions of the empty stomach, Carlson suggested that hypoglycemia, acting upon the stomach, might be responsible for inducing these contractions [26] However, this theory became untenable when it was demonstrated that total denervation and surgical removal of the stomach did not fundamentally alter the characteristics of the regulation of the intake of food.

Thermostatic Mechanism Theory

In the process of assimilation of food, there is a rise in the total production of body heat This extra heat is termed "specific dynamic action,' and varies with the different types of foodstuffs, proteins having the highest, and fat, the lowest Booth and Strang observed a rise in skin temperature following eating They correlated this with the onset of satiety They found that their subjects were unable to continue eating when there was a rise in skin temperature of 0 9°C in 22 minutes [12] Strang and McCluggage found that a considerable difference in the rate of heat production existed between thin obese, and normal people The greatest rate

of heat production was found in underweight individuals and the lowest rate in the obese They admitted the dif ficulty of trying to establish a relationship between satiety and the physiological stress resulting from the specific lynamic action of food However assuming such a rela ionship the rapid rate of heat production in the thin person used an early feeling of satisfaction The slower rate of at production in the obese caused the individual to reach turation much later if at all so a normal brake on eating s damaged [108]

Brobeck stated that animals eat to keep warm and stop eating to prevent hyperthermia Since the hypothalamus is known to contain temperature sensitive cells it seems reasonable to suppose that the specific dynamic action may play a role in selectively altering the drive from the feeding center and thus cut off or otherwise alter the feeding re flexes [15]

However there are several contradictions to this thermo- static theory It does not explain the hyperphagia caused by insulin or diabetes Thyroxine a hyperthermic agent, causes an increased intake of food while thiouracil or thyroidectomy causes a decrease It has been demonstrated that in acclimatized hypothalamic animals, whose intake is not depressed by high environmental temperatures The central temperature of hyperphagic animals is higher than that of nonhyperphagic controls and finally the short-term deprivation of food increases the central temperature [7 78]

Glucostatic Mechanism Theory

Recently Mayer has returned to the concept that blood glucose is the main factor regulating the rate of food

reasoning behind this theory, as stated by Mayer, is as follows "The regulation of food intake proceeds by relatively frequent partaking of food (meals) It is improbable that the hypothalamic centers are sensitive to decrease of the body content of proteins or fats, since during the short interval between meals, the decrease is proportionally very small On the other hand, the body stores of carbohydrate are limited The postprandial liver glycogen in man is only about 75 Gm In the postabsorbtive period, these stores are rapidly depleted The nervous system depends exclusively on glucose Thus, it would appear possible that the nervous system contains glucoreceptors' sensitive to fluctuations of available blood glucose' [77, 78]

A crude test of this hypothesis was provided by a survey of the effects of various metabolites on the effect of intake of food of normal animals Increase in levels of blood sugar was obtained by injections of glucose, fructose, or epinephrine Decreases were obtained with insulin Hypoglycemic levels were avoided It was found that temporary increases in blood glucose levels corresponded to decreases in food intake, and vice versa, even when the caloric equivalent of injected metabolites was taken into account Substances without effect on blood glucose did not influence food intake over and beyond the caloric value of these substances [77]

The absolute values of blood glucose, however, could not be the determining factor, else how could the hyperphagia of diabetes mellitus, hyperthyroidism, or that existing in obesity where there is a tendency to hyperglycemic blood levels be explained For variation of blood sugar levels to influence hypothalamic glucoreceptors, glucose has to cross the membranes of these cells, thus, utilization of available blood glucose is of major importance [77, 78]

This concept was tested in human subjects by measuring the concentration of glucose in simultaneously obtained specimens of blood from an antecubital vein and a finger tip (venous and capillary blood) The difference was designated as Δ glucose Δ Glucose values were found to correspond closely with the caloric intake of the individual, and with hunger feelings

Adequate diets were associated with large Δ glucose values, while submaintenance diets were associated with rapidly decreasing Δ glucose values after meals Values of 15 mg per 100 cc were associated with satiety, those near zero with hunger [83]

In diabetes mellitus since glucose is not adequately utilized the concentration of blood sugar had to be forced up through ingestion of food to levels were arteriovenous differences were introduced for hunger to be satisfied

In hyperthyroidism glucose is metabolized very rapidly It is possible that the increased food intake of food characteristic of hyperthyroidism may be related to a metabolic hypoglycemia

Conclusions

It is evident that the physiological regulation of intake of food is exceedingly complicated No matter what metabolic factors are involved, other factors such as habits, environment physical characteristics or palatability of food, emotional associations social stimuli and reactions to stress are involved to a variable degree and cannot be quantitatively measured [78]

CHAPTER 7

Etiology: Hereditary, Psychological, Nervous, and Dietary Factors

EXCESS FAT can come from only one source, ingested food In an otherwise healthy individual, food intake in excess of the energy requirements of the body is converted into and stored as fat If the amount of food eaten is in balance with the energy expended, there can be no accumulation of fat Any deviation from this concept contradicts fundamental physical laws of conservation of energy

In the average healthy person, the amount of food eaten is nicely attuned to the energy requirements of the body, and the weight remains fairly constant at a satisfactory level Anything which disturbs this equilibrium will cause a deviation from the desirable weight Thus, obesity may be caused by increased intake of food, decreased work output, or decreased rate of heat production, acting singly or in combination

In this connection, we asked 108 consecutive obese patients why they thought they were fat Fifty four (50 per cent) admitted frankly that they ate too much, while an additional 17 (15 per cent) although blaming their obesity primarily on other factors, admitted they overate Thus 65 per cent of these patients implicated faulty dietary habits

as the cause of their obesity Popularly held reasons for obesity, such as pregnancies, the menopause, heredity, and glandular disturbances, not accompanied by admissions of overeating accounted for only 18 per cent of the answers 17 per cent of the patients stated they did not know why they became obese [43]

The disproportion between energy intake and output as the immediate cause of obesity is almost universally accepted But what mechanisms operate to bring about this disproportion? Why should the homeostatic mechanisms which operate so efficiently in most people to enable them to maintain a desirable weight without their giving a second thought to what they eat, break down in the obese? The final answer, or answers to these questions are unfortunately still lacking A wide variety of factors have been implicated as the fundamental abnormality leading to obesity Some of these will be discussed in the ensuing sections

Heredity

It has been observed that obesity in many instances is familial Gurney in a study of 75 obese women, found that 82 per cent had one or both parents who were obese, while in only 38 per cent of individuals of normal weight did such a situation exist He noted that if both mother and father were markedly overweight, 73 per cent of the offspring were abnormally fat, if only one parent was overweight 59 per cent of the offspring were excessively heavy, while if both parents were of normal weight, only 9 per cent of the offspring were obese [43] In a similar study of 39 obese patients, we found that in 87 per cent, one or both parents were overweight [39]

Hereditary obesity has been studied in different animals

The yellow strain of mice, and the obese hyperglycemic syndrome of mice have been extensively investigated The obesity of the Danforth strain of yellow mice is transmitted by a dominant gene These mice attain a weight two to three times greater than nonyellow littermates Both males and females develop obesity The intake of food of these obese mice is increased, while activity is diminished These animals will lose weight as calculated when their diets are restricted [99]

The obese hyperglycemic syndrome of mice is also characterized by extreme obesity, and has been demonstrated to be controlled by a single recessive gene This syndrome has been intensively studied by Mayer and associates The average consumption of food by these animals is about 20 per cent greater than those of normal weight However, measurements of activity reveal that normal mice are 50 to 100 times more active than the obese mice The inactivity precedes the development of obesity Thus even when a genetic factor can be positively implicated in the etiology of obesity, a disproportion between every intake and output must exist before obesity can develop When these factors are controlled so that the disproportion is eliminated there is no excess accumulation of fat [78]

On the other hand, unless exceptional genetic conditions were present, it has not been possible to produce excessive deposition of fat in experimental animals by purely dietary means Fenton and Carr observed the weight response of four different strains of mice to variations in the fat content of the diet An increase in the rate of gain in weight was noted in only two of the strains, thus suggesting that genetic factors are involved. Whether these results obtained with

mice can be applied to the problem of obesity in man is uncertain [37]

✓There is no disputing the fact that individuals are built differently Some are much larger than others However, mere size, or a large frame, does not constitute obesity It is the amount of *padding* on the framework that determines that, and such padding must be acquired

While the matter is not definitely settled, we feel that the tendency for obesity to *run in families* depends more upon environmental than hereditary factors It has been found that the body weight showed greater variation than any other characteristic in identical twins who were separated at an early age and subjected to different environments [35]

Children eat at the same table as their parents, and imitate and learn the same eating habits Since faulty eating habits were concerned in the obesity of the parents, duplication of these habits in the offspring will result

Gurney found that among the overweight patients he studied 43 per cent had an obese mother, while 15 per cent had an obese father [48] In our group, the ratio was 46 per cent and 18 per cent respectively Since the mother has the greater control of the child s diet during the formative years, *it is likely that she tries to force her methods* of eating upon her children

The separation of the relative influence of heredity and environment is as difficult for obesity as for many other characteristics *Much of the evidence points to the dominance* of environmental factors in most individuals In any case, the hazards of overweight are essentially the same in both groups, and both will respond to a properly controlled

weight reducing regimen That one is a member of an obese family should be no deterrent to a desirable loss of weight

Psychological Factors

Eating is a popular outlet for anxieties and frustrations It substitutes a pleasurable sensation for the unpleasant feelings engendered by emotional strain Obesity affords some individuals an excuse for other inadequacies It protects them from being forced to do hard work or other unpleasant tasks Their appearance is used as an excuse for failing to indulge in normal social activities and as a result normal responsibilities of marriage parenthood and community obligations are often avoided

A Freudian concept sees obesity as the result of arrested sexual development the libido remaining at the oral stage The mouth is the erotogenic zone and the partaking of food is the gratification

Once obesity has become established the individual feels himself different from others and he may tend to isolate himself Emotional problems are thus increased and a vicious circle is set up

This type of individual looks for some factor beyond his control as the cause of his obesity as a *face saving* mechanism Any implication by the physician that his obesity is caused by glands or heredity is just what the patient is seeking and can result in irreparable harm

This patient must be told bluntly that his overweight is caused by overeating By using food as the solution for his problems a habit pattern becomes established This habit must be broken and the patient must be re educated in proper eating habits (See chapter on diet management)

Psychic stress, however, does not invariably result in overeating Many individuals react quite the opposite, a loss of weight caused by a reduction of appetite will ensue It is impossible to state whether increased or decreased intake of food will result from psychic stress in different individuals, or in the same individuals at different times Patients with anorexia nervosa may demonstrate alternate periods of obesity and leanness

The Hypothalamus

Destruction of specific portions of the hypothalamus will result in obesity [53] The exact locations of these lesions vary in different species These lesions can be made at will in experimental animals by means of the Horsley-Clarke stereotaxic needle In rats, the ventrolateral bodies of the ventromedial nuclei must be destroyed These lesions will produce obesity whether the anterior pituitary is present or not No amount of pituitary damage will cause obesity if the hypothalamus is intact

Animals in whom such lesions were made develop an enormous voracious appetite They may be said to attack their food The term "hyperphagia" best expresses their abnormal appetites and methods of eating

Many studies have been made on animals in whom obesity was induced by hypothalamic injury to see whether there were any changes in normal physiological functions The outstanding characteristic of these animals was their voracious appetite These animals showed an increase in average meal size, and ate more frequently This abnormal appetite came on immediately after the lesion was made Surgical reduction of the size of the stomach did not prevent the development of obesity The animals merely ate

smaller amounts more frequently The hyperphagia was not abolished by long continued limitation of food [20]

When animals in whom the medial hypothalamic nuclei have been destroyed are pair fed with normals, the operated animals, in some cases, gain weight slightly faster It is thought that the method of eating of the operated animals is responsible for this Brobeck found that when normal animals are taught to devour their food rapidly, they gain equally with their operated pair [15]

In the obese animals, blood lipids are high and fat in the liver is excessive [15] However, a comparison of the dry weight of the feces with the dry weight of the food ingested by normal and obese rats shows no significant difference, indicating no change in intestinal absorption [21] Chemical analysis of the accumulated fat in the obese animals reveals nothing remarkable Obese animals utilize their stored fat when they are starved The respiratory quotient (RQ) during starvation is the same as that observed in normal animals [14 15, 17, 19]

Recent studies utilizing deuterium oxide have demonstrated that there is no excessive rate of absorption of food or deposition of fat in hypothalamic animals The *fraction* of depot fat mobilized per day is extremely small. The *quantity* of depot fat mobilized *is likewise small* but it could not be determined definitely that it was less than normal [74]

Immediately following the destruction of the ventral hypothalamic nuclei there is some decrease in activity However, activity gradually increases in frequency and intensity The greater weight of the animal requires more energy for movement, and the weight shift involved in such activities as eating and washing becomes significant The

recorded activity finally exceeds the preoperative activity of the individual even before weight gain has ceased Thus, the great increase of weight of these animals cannot be attributed to inactivity [18]

In some animals, there is an increase in the RQ during the period of rapid weight gain (dynamic phase) Only those few animals that demonstrated this rise in RQ outgained normals in paired feeding experiment This increased RQ has been attributed to the voracious method of eating of the hyperphagic animals The administration of thyroxin to hypothalamic animals to elevate the metabolic rate retarded, but did not completely abolish the gain in weight [15, 18, 21]

In some animals with such hypothalamic lesions, there are noted hypoplasia of the gonads and genitalia and abnormalities of the estrous cycle This is independent of pituitary damage, and is not necessarily related to such damage Brobeck suggested that the ingestion of large quantities of food and the rapid deposition of fat require large amounts of accessory food factors (vitamins), and that the above findings may be a result of deficiencies of these [14] However, since it has been noted that adjacent lesions in the hypothalamus which do not cause hyperphagia frequently lead to disturbances of the sexual processes, these changes may have been caused by the extent of the lesion and are, therefore, independent of the hyperphagia [78] Since the centers for many vital functions lie close together in the hypothalamus, and it is difficult exactly to control the extent of the destructive lesion, the latter explanation seems the more likely

Insulin is required for storage of fat Relatively large amounts are needed in the rapid deposition of fat caused

smaller amounts more frequently The hyperphagia was not abolished by long continued limitation of food [20]

When animals in whom the medial hypothalamic nuclei have been destroyed are pair fed with normals, the operated animals, in some cases, gain *weight slightly faster* It is thought that the method of eating of the operated animals is responsible for this Brobeck found that when normal animals are taught to devour their food rapidly, they gain equally with their operated pair [15]

In the obese animals, blood lipids are high and fat in the liver *is excessive* [15] However, a comparison of the dry weight of the feces with the dry weight of the food ingested by normal and obese rats shows no significant difference indicating no change in intestinal absorption [21] Chemical analysis of the accumulated fat in the obese animals reveals nothing remarkable Obese animals utilize their stored fat when they are starved The *respiratory quotient* (RQ) during starvation is the same as that observed in normal animals [14, 15, 17, 19]

Recent studies utilizing deuterium oxide have demonstrated that there is no excessive rate of absorption of food or deposition of fat in hypothalamic animals The *fraction of depot fat mobilized per day* is *extremely* small. The *quantity* of depot fat mobilized is likewise small but it could not be determined definitely that it was less than normal [74]

Immediately following the destruction of the ventral hypothalamic nuclei there is *some* decrease in activity However activity gradually increases in frequency and intensity The greater weight of the animal requires more energy for movement, and the weight shift involved in such activities as eating and washing becomes significant The

recorded activity finally exceeds the preoperative activity of the individual even before weight gain has ceased. Thus the great increase of weight of these animals cannot be attributed to inactivity [18]

In some animals there is an increase in the RQ during the period of rapid weight gain (dynamic phase) Only those few animals that demonstrated this rise in RQ out gained normals in paired feeding experiment This in creased RQ has been attributed to the voracious method of eating of the hyperphagic animals The administration of thyroxin to hypothalamic animals to elevate the metabolic rate retarded but did not completely abolish the gain in weight [15 18 21]

In some animals with such hypothalamic lesions there are noted hypoplasia of the gonads and genitalia and ab normalities of the estrous cycle This is independent of pituitary damage and is not necessarily related to such damage Brobeck suggested that the ingestion of large quantities of food and the rapid deposition of fat require large amounts of accessory food factors (vitamins) and that the above findings may be a result of deficiencies of these [14] However since it has been noted that adjacent lesions in the hypothalamus which do not cause hyper phagia frequently lead to disturbances of the sexual proc esses these changes may have been caused by the extent of the lesion and are therefore independent of the hyper phagia [78] Since the centers for many vital functions lie close together in the hypothalamus and it is difficult exactly to control the extent of the destructive lesion the latter ex planation seems the more likely

Insulin is required for storage of fat Relatively large amounts are needed in the rapid deposition of fat caused

by the hyperphagia Glycosuria is more common in the obese animals It is possible that adequate amounts of insulin are not available to take care of all metabolic requirements [15]

Both Brobeck and Brooks conclude that the major cause of experimentally produced obesity is the breakdown of the balance between food intake and energy utilization The metabolic effects of hypothalamic injury are probably secondary to the hyperphagia [16, 19]

Recently, this view has been challenged Some investigators feel that the problem is more complex, and involves a general metabolic disturbance Disturbances in calcium, phosphorus, and iron metabolism have been noted in hypothalamic animals [54] The intake of food varies with the type of diet, being greatest when a high fat diet is offered Very little hyperphagia is observed when the animals are fed a high protein diet [68] Mayer found that during the active phase of weight gain, an excellent degree of correlation could be established between the lowering of the non fasted blood sugar levels and the hyperphagia He suggested, in keeping with his glucostatic theory, that the increased rate of lipogenesis prevented satiety glucose levels to be reached [78]

When hypothalamic animals are forced to *work* to obtain their food, it has been found that they eat *less than control* animals Thus, it would seem that hypothalamic animals eat excessively not because of an overwhelming urge to eat, but rather because of a failure of satiety 'The lesions interfere seriously with the mechanism of stopping eating and somewhat less seriously with the mechanism of hunger [80]

Bilateral destruction of a small region in the lateral hypothalamus will result in complete anorexia Rats and cats so

operated upon die of starvation although food is present in their cages When the regions causing hyperphagia and anorexia are simultaneously destroyed, inanition will result Hyperphagic animals in whom the lateral centers were destroyed at a later date ceased to eat It has been concluded that the lateral regions are the locations of the appetite center, the location of the receptor cells and effector neurons The medial centers are the inhibitors of the appetite center [3] Whether this effect of the medial on the lateral centers is mediated by a direct neural inhibition, as suggested by Anand [3] or acts indirectly through some underlying metabolic disturbance, as advocated by Mayer [78], has not as yet been established

Dietary Factors

Many dietary factors have been implicated as to why some people become obese Thus, it has been suggested that fat people eat excessive amounts of carbohydrates, fats or fat rich foods, or normal amounts accompanied by decreased activity Also, such individuals are said to eat large amounts at one sitting, have an excessive amount of snacks, or eat most of their food at the evening meal

Using a special type of dietary history method, Beaudoin and Mayer found that the average intake of food by obese individuals was derived from the same proportions of fat (37 per cent) and carbohydrates (49 per cent) as that of normal persons Both obese and normals were found to have snacks in similar proportions [8]

Apparently there is not a great deal of difference qualitatively between the diets of obese and normal individuals It would appear that the main difference is quantity

CHAPTER 8

Etiology: Metabolic Factors

OBESITY is the result of a chronic disproportion between caloric intake and energy output Derangements of either or both of these factors by some metabolic error could cause such a disproportion Various abnormalities of energy exchange have been suggested as the cause of obesity

Some early studies attempted to show that no significant change in weight would ensue in some thin and obese persons no matter what modifications were made in their diet or activity Strouse and Dye studied five cases One was very thin A 50 per cent increase in food intake and reduction of activity caused no increase in weight after four weeks Conversely, four obese persons whose caloric intake was markedly reduced showed negligible weight loss after one week to four months [*112*]

All these individuals, however, were followed on an outpatient basis We have found that no reliance can be placed on patients' reports as to how much they ate A group of obese individuals were instructed to keep daily score cards as to what and how much they ate The daily caloric intake was then calculated for each patient It was found that most subjects maintained their weight, and even gained weight on admitted caloric intakes of less than 1000 calories a day,

some as low as 400 or 500 calories a day for periods of at least two weeks This is a most unusual finding [39]

In a study of eight obese patients who were hospitalized and allowed a free choice of food, Strang, McCluggage and Evans found an average intake of 2570 calories a day Moreover, even on such a relatively high caloric intake, a loss of weight averaging two pounds in four days was observed [*111*]

It has repeatedly been demonstrated in careful metabolic studies where the intake of food can be controlled and measured, that changes in weight can be predicted with considerable accuracy [*84, 85, 125*]

Practically every physician is familiar with the obese patient who insists he is a very small eater Part of the explanation for this is the confusion that exists in the minds of many between bulk and food value Small amounts of butter, or pastry will afford considerably more calories than a much larger amount of lettuce, but be much less filling An excess of 100 calories a day will result in the deposition of ten pounds of fat in a year Since 100, or even 200 calories is so small when compared to the total daily intake, it is easy to understand why so many obese patients insist they do not eat more than the average

One patient was observed who requested treatment for underweight A high caloric diet, frequent feedings, and various food supplements caused only a very slight gain in weight after two months The patient insisted that he fol lowed the dietary instructions, and was eating more than he ever did This same patient developed a duodenal ulcer about a year later He was then forced to indulge in frequent feedings, and he drank large quantities of milk in order to be free of his ulcer symptoms The resultant gain

CHAPTER 8

Etiology: Metabolic Factors

OBESITY is the result of a chronic disproportion between caloric intake and energy c
or both of these factors b
cause such a disproportion Various abnormalities of energy exchange have been suggested as the cause of obesity

Some early studies attempted to show that no significant change in weight would ensue in some thin and obese persons no matter what modifications were made in their diet or activity Strouse and Dye studied five cases One was very thin A 50 per cent increase in food intake and reduction of activity caused no increase in weight after four weeks Conversely, four obese persons whose caloric intake was markedly reduced showed negligible weight loss after one week to four months [*112*]

All these individuals, however, were followed on an outpatient basis We have found that no reliance can be placed on patients' reports as to how much they ate A group of obese individuals were instructed to keep daily score cards as to what and how much they ate The daily caloric intake was then calculated for each patient It was found that most subjects maintained their weight, and even gained weight on admitted caloric intakes of less than 1000 calories a day,

some as low as 400 or 500 calories a day for periods of at least two weeks This is a most unusual finding [39]

In a study of eight obese patients who were hospitalized and allowed a free choice of food, Strang, McCluggage and Evans found an average intake of 2570 calories a day Moreover, even on such a relatively high caloric intake, a loss of weight averaging two pounds in four days was observed [*111*]

It has repeatedly been demonstrated in careful metabolic studies where the intake of food can be controlled and measured, that changes in weight can be predicted with considerable accuracy [*84*, *85*, *125*]

Practically every physician is familiar with the obese patient who insists he is a very small eater Part of the explanation for this is the confusion that exists in the minds of many between bulk and food value Small amounts of butter, or pastry will afford considerably more calories than a much larger amount of lettuce, but be much less filling An excess of 100 calories a day will result in the deposition of ten pounds of fat in a year Since 100, or even 200 calories is so small when compared to the total daily intake, it is easy to understand why so many obese patients insist they do not eat more than the average

One patient was observed who requested treatment for underweight A high caloric diet, frequent feedings, and various food supplements caused only a very slight gain in weight after two months The patient insisted that he followed the dietary instructions and was eating more than he ever did This same patient developed a duodenal ulcer about a year later He was then forced to indulge in frequent feedings, and he drank large quantities of milk in order to be free of his ulcer symptoms The resultant gain

in weight was so rapid that it was necessary to institute dietary restrictions to prevent excessive gain of weight

Increased Efficiency of Digestion and Absorption

It is obvious that if one individual absorbs more of a similar meal than another, his caloric intake is greater However, it has been found that the caloric value, nitrogen, and *fat content of the feces are the same for obese and normal individuals on comparable diets* Similar findings have been described when underweight subjects were compared to normal persons [*109*] In their studies on rats made obese by *hypothalamic lesions, Brooks and his co-workers could* find no difference between obese and control animals when the dry weight of the feces was compared to the dry weight of the food [*21*]

Nitrogen Exchange

Strang, McCluggage and Evans found that the level of nitrogen exchange in obese individuals on a restricted diet was normal if 0 16 Gm of nitrogen per kilogram of ideal body weight was furnished, and that this was no different from that observed in normal individuals [*110*]

The nitrogen output in undernourished individuals undergoing treatment with a high caloric diet is less than normal at the outset, and after treatment *It is the undernourished* individual who handles energy conservatively and with little body waste [*109*]

Respiratory Quotient

The respiratory quotient represents the relationship between oxygen intake and CO_2 output Expressed mathemat-

ically, $RQ = \frac{CO_2}{O_2}$ The respiratory quotient of carbohydrate is 1 0, of protein 0 80 and of fat 0 71

When an oxygen-rich substance is converted to an oxygen-poor substance, which occurs in the conversion of carbohydrate to fat, the respiratory quotient will rise On the other hand, when fat is metabolized, the respiratory quotient will be low Because of these facts, the respiratory quotient has been exhaustively studied in order to determine whether any metabolic difference existed between obese and normal individuals Hagedorn found the respiratory quotient in the postprandial state higher in the obese than in normals This was interpreted as proving an increased conversion of carbohydrates to fats in the obese He also found a lower respiratory quotient in obese individuals in the post absorptive phase [49] Brooks found that there was an elevation of the respiratory quotient after eating during the dynamic phase of obesity (period of rapid gain of weight) in animals with hypothalamic lesions This was attributed to the ravenous way these animals ate and the rapid deposition of fat secondary thereto During the static phase of obesity, these animals had normal respiratory quotients [17]

During dietary restriction, there is no difference in the respiratory quotient between obese and normal individuals, indicating that the obese can metabolize their fat in the same manner as normal persons [107]

The finding of an elevated respiratory quotient following a meal does not necessarily mean the conversion of carbohydrate to fat The oxidation of carbohydrates and the formation of acid metabolites, such as lactic acid, increases the output of carbon dioxide and thus the respiratory quotient The occasional finding of a decreased fasting respira-

in weight was so rapid that it was necessary to institute dietary restrictions to prevent excessive gain of weight

Increased Efficiency of Digestion and Absorption

It is obvious that if one individual absorbs more of a similar meal than another, his caloric intake is greater However, it has been found that the caloric value, nitrogen and fat content of the feces are the same for obese and normal individuals on comparable diets Similar findings have been described when underweight subjects were compared to normal persons [109] In their studies on rats made obese by hypothalamic lesions, Brooks and his co workers could find no difference between obese and control animals when the dry weight of the feces was compared to the dry weight of the food [21]

Nitrogen Exchange

Strang McCluggage and Evans found that the level of nitrogen exchange in obese individuals on a restricted diet was normal if 0 16 Gm of nitrogen per kilogram of ideal body weight was furnished, and that this was no different from that observed in normal individuals [110]

The nitrogen output in undernourished individuals under going treatment with a high caloric diet is less than normal at the outset and after treatment It is the undernourished individual who handles energy conservatively and with little body waste [109]

Respiratory Quotient

The respiratory quotient represents the relationship be tween oxygen intake and CO_2 output Expressed mathemat

Strang and Evans, on the basis of their own data and calculations based upon data obtained by others, found a 25 to 30 per cent increase in the basal metabolic rate [107]

The excess fat is what causes the increase in surface area Adipose tissue is not merely an inert storage depot It is part of the reticuloendothelial system with a definite, active function, and a specific carbohydrate metabolism However, it has been calculated that the metabolic activities of fat tissue contribute probably less than 10 per cent to the excess heat production [98]

The excessive rate of metabolism may contribute to the greater incidence of degenerative diseases in overweight individuals (Chapter 1) They *burn themselves out* faster

During weight reduction by dietary means, the basal metabolic rate remains within normal limits if an adequate amount of protein is provided Some studies demonstrated a lowering of the basal metabolic rate during weight reduction This was probably caused by an inadequate intake of protein [99] During weight reduction the rate of heat production diminishes to a greater extent than either the weight or surface area, but never goes below the theoretical normal level [107]

Specific Dynamic Action

The specific dynamic action of food refers to the increased metabolism above the basal rate caused by the metabolism of food The increase caused by protein is 30 per cent, that caused by carbohydrate 6 per cent, and that caused by fat 4 per cent

The determination of the specific dynamic action is difficult Since it measures the increase in metabolism over the basal level, the establishment of a true baseline is impera-

tory quotient in the obese represents an increased metabolism of fat This may be necessary because of decreased glycogen stores, and is consistent with the usual findings of pathological changes in the liver in obesity plus the possibility that the increased level of metabolism in the obese depletes glycogen stores more rapidly [99]

There have been no consistent and significant differences noted in the respiratory quotients of obese and normal individuals that would indicate fundamental variations in metabolism Changes noted in some studies may be just as well explained by other factors The respiratory quotient is at best difficult to measure accurately It represents the total of a great number of complex reactions going on at the same time As Long has stated, it is probable that too much emphasis has been placed on the level of the respiratory quotient as evidence that a certain single process is or is not occurring [35]

Basal Metabolic Rate

The basal metabolic rate represents the basal heat production of the body in relation to the surface area Strouse and Dye [113] found that [illegible] eight nor underweight was associate[illegible] the basal metabolic rate [illegible] that the basal metabolic rate was within normal limits in the obese The vast majority of patients in our clinic presented no abnormality in their basal metabolic rate [39, 40 41]

While the basal metabolic rate is usually normal in obesity, the total basal heat production per hour is excessively high since the surface area is relatively greatly increased When heat production was related to the ideal surface area,

about 200 calories would represent the specific dynamic action If obesity depended upon this specific dynamic action, it would have to drop 30 to 50 per cent in mild cases, and completely disappear in severe cases Such changes should be demonstrable The failure to be able to do so is in opposition to the suggested causal relationship of reduced specific dynamic action to obesity [*108*]

Rebound of Metabolism

A decrease in metabolic rate to below the baseline after the rise caused by the ingestion of food was found in obese individuals by Bernhardt This decrease was also thought to follow exercise This saving in metabolism could account for an increase in weight after a prolonged time However, neither Wilder, nor Strang and McCluggage were able to demonstrate this rebound effect in their studies [*108, 125*]

Luxury Consumption

This is a term for a mechanism whereby normal individuals compensated for an increased caloric intake by an increase in metabolism Grafe postulated that such a mechanism was absent in the constitutionally obese [*46*]

It is true that undernourished persons will respond to an adequate diet with an increase in metabolism However, this is no proof that such happens in normally nourished individuals nor has this been demonstrated. An increase in metabolism will occur in superalimentation only when there is also protein overfeeding and is probably caused by the specific dynamic action of the protein [98]

Ketosis

MacKay and Sherrill, in their studies on metabolic changes, found that some obese subjects, while fasting, de-

tive Considerable training and practice are necessary before any individual becomes a satisfactory subject Determinations must be carried on for a sufficient length of time Since the stomach may not completely empty itself for three or more hours the study must be continued for several hours beyond that

The method of expressing the increase in metabolism is also important If it is represented as the per cent increase the specific dynamic action in the obese will be relatively low, since they start with a high baseline caused by their increased rate of heat production It is better to express the specific dynamic action as the total increase in heat production rather than the per cent increase [35]

Using a group of trained subjects, and continuing the study for eight hours Strang and McCluggage found no significant quantitative difference between obese, normal, and thin individuals in the total increase of heat production They used a diet which supplied 610 calories The additional heat produced was 57 calories The cost of digestion was, then, 9 per cent [*108*] Benedict found it to average about 6 per cent in his series, using a different diet Wilder stated that, at best, it is no more than 10 per cent [*125*]

Wilhelmj in a comprehensive summary of the problem of specific dynamic action quotes studies demonstrating no change in the specific dynamic action in pituitary disease after hypophysectomy in dogs, in exophthalmic goiter and hypothyroidism, and in adrenalectomized dogs He also noted that the specific dynamic action is not a function of the amount of food ingested, but of the amount metabolized and varies with the state of nutrition [*128*]

It has been demonstrated that an intake of about 100 calories a day in excess of requirements will result in a gain of ten pounds in a year On a diet of 2500 calories a day,

weight with age noted in the older tables of standard weight (Chapter 1) is probably a result of this However, this increase in weight is relatively small, and normally does not result in clinical obesity

Mayer found that abnormality of energy exchange in the hereditary obese hyperglycemic syndrome in mice was associated with a marked decrease of activity by these animals [78] However, it is questionable whether inactivity is important in the etiology of most cases of human obesity In our study of the subjective impressions of overweight individuals as to the cause of their obesity, only two of the 108 patients questioned attributed their obesity to inactivity [43] Enforced inactivity, such as the result of accident, illness, or surgery is probably accompanied by a great deal of psychic stress which may concomitantly pervert the normal appetite mechanism Conversely, the same emotional disorders which might cause a voluntary decrease of activity could also cause an increase in the intake of food In other words, inactivity is not necessarily the cause of obesity, both may be the result of some common situation

Lipophilia

This is a term used by Bergman to describe an abnormal tendency of obese individuals to fix fats, and an increased difficulty in losing fats from their depots Hetenyi made several observations in support of this concept He found that in undernutrition, the blood lipid level in individuals of normal weight remained unchanged, but decreased in the obese Obese individuals given a fatty meal had a lesser increase in blood lipids than normals He also found that if olive oil were injected into the lean upper extremities of persons with lipodystrophy, absorption was normal, but

veloped a greater ketosis than normal individuals, and some had very little ketosis They believed that the obese became ketotic during starvation because they burned a greater amount of fat Those subjects that showed a diminution in ketone bodies were thought not to have a simple obesity Their fat was considered *locked* in storage depots and was not available for metabolism An endocrine basis was suggested for this phenomenon [71]

If the above were correct, what sort of metabolic mixture were these individuals utilizing? Energy is derived from the metabolism of carbohydrates, proteins, and fats Those individuals who had decreased ketosis were believed not to be metabolizing fats If proteins were being utilized to supply the energy which the locked fats could not, there should have been a distinctly greater negative nitrogen balance in this group Unfortunately, such balance studies were not included

There was no previous dietary control in any of these studies It is possible that the difference in the nutritional status between these groups caused the variation in the amount of ketosis rather than any peculiarity of the stored fat

The entire subject of the ketosis present in obesity is confused Some investigators have and some have not found increased ketosis a constant finding during the dietary correction of obesity The absence of any consistency in these various experimental studies casts considerable doubt on the causal relationship between ketogenesis and obesity

Physical Activity

A decrease in activity will, of course, result in an increase of weight if the diet remains constant The increasing

CHAPTER 9

Etiology: Endocrine Factors

DYSFUNCTION OF one or another of the endocrine glands has often been considered a cause of obesity Not only have many glands been thus implicated but even when a gland has been singled out as the etiological factor in a particular case, there has been no agreement as to whether hypofunction or hyperfunction exists The incidence of frank evidence of endocrine dysfunction in overweight individuals (other than their obesity) is small. Of 200 unselected cases of obesity studied by Rony, only 13 had definite evidence of endocrine disease [98] Even this small number may be somewhat exaggerated, since it is sometimes difficult to determine whether the endocrine disturbances are independent lesions, the cause of the obesity, or manifestations secondary to it It is likely that endocrine diseases cause obesity in only a relatively small number of cases

Some of the glands which, because of some abnormality of function, have been thought to cause obesity, are discussed below

THYROID

Hypofunction of the thyroid gland is one of the most frequently implicated endocrine causes of obesity The gain

when injected into the fat lower extremities, absorption followed the pattern observed in the obese [35]

Increased lipogenesis and difficulty in mobilizing fat reserves has been demonstrated in the obese hyperglycemic syndrome of mice [78] However, no increase in the rate of lipogenesis could be demonstrated in animals made obese by hypothalamic lesions In these latter animals, it could not be established with certainty that there was a decreased ability to mobilize depot fats [74]

The concept of lipophilia has not been established in human obesity In controlled studies where obese individuals have been observed on submaintenance diets, the rate of loss of weight has been as calculated If an adequate amount of protein were allowed, the patients remained in nitrogen balance This should not be the case if there were any impairment of fat mobilization In addition the BMR has almost always been normal in obese human beings whereas hypometabolism has been characteristic of the obese hyperglycemic syndrome of mice

In conclusion, it can be stated that no peculiar mechanism for controlling energy, as is implied in the concept that the amount of food intake has no effect upon the weight of some individuals, can be demonstrated Subjective impressions of the amount of food eaten are unreliable and misleading Careful, controlled studies have been unable to confirm the conclusion drawn from data based upon such impressions

obesity followed castration in some animals However, this is probably a species reaction Castrated humans are not necessarily obese Eunuchs may be of normal weight, or even lean In some civilizations where castration is performed in all males above a certain age, the incidence of obesity is not found to be excessive

Many individuals date their obesity to a time when major gonadal changes occur, such as puberty, pregnancy, or the climacterium However, changes in hormonal functions at these times are completely different There is increasing gonadal function at puberty while the climacterium represents waning glandular function We are again faced with attributing the same phenomenon (obesity) to hypo and hyperfunction of the same gland

Aside from the differences of endocrine changes, there is no constancy regarding the development of obesity at these various times Actually, some individuals lose weight then Obese children frequently lose weight at the time of puberty A loss of weight following the menopause is also not uncommon Weight tables show no rapid changes in those age groups in which these variations in gonadal function occur, suggesting that there is no startling deviation of weight for the average individual coincident with these changes

Menstrual disorders and sterility are frequently present in the obese women Their correction, which frequently occurs after weight reduction, makes it likely that they are secondary to the obesity, rather than a cause of it

Pituitary

In the early part of this century, Frohlich described a syndrome consisting of trophic disturbances such as infan-

in weight has been attributed to the low level of metabolism In a study of 53 patients with mild hypothyroidism Seward found that 14 patients under 40 years of age, and 1 over 60 complained of weight loss, while 12 patients over age 40 gained weight. Sixteen patients under age 35 were underweight and 2 were overweight Of those over age 40 12 were overweight and 2 were underweight [*100*]

Plummer analyzed 200 cases of spontaneous myxedema Sixty-one and one half per cent were overweight, and 38½ per cent were underweight There was no quantitative relationship between weight and the level of the basal metabolic rate The average loss of weight after thyroid therapy was instituted was about 18 pounds The greater the degree of myxedema, the greater was the loss of weight, suggesting that it was edema fluid that was eliminated, not body tissue When all the excess fluid was eliminated, the average weight for the group was somewhat below normal He suggested that there appears to be a loss of body flesh which is replaced by edema fluid in well established cases of myxedema [*91*]

Hypothyroid and myxedematous patients are not necessarily obese Conversely, most obese individuals do not have a low basal metabolic rate (See section on oxygen exchange)

GONADS

The distribution of fat is obviously different in men and women However, mere differences in the distribution of fat do not consitute obesity There must be an excess amount of fat deposited

Several observations have led to the belief that obesity was associated with gonadal dysfunction The first was that

sulted in a marked increase of the circulating neutral fat which is ordinarily absorbed and metabolized by the liver Posterior pituitary hormone had no effect upon the level of the circulating neutral fat when injected into dogs in whom such lesions of the nervous system were made

Raab concluded that "Pituitrin promotes the absorption and destruction of circulating fat by the liver through nervous pathways starting in the tuber cinereum and running through the cervical cord and the abdominal splanchnic nerves to the liver Any disturbance of the cooperative pituitary mesencephalic system would lead to a retention of excess amounts of fat in the body and thus lead to obesity" [94]

Adrenal

Cushing's disease is caused by hyperfunction of the adrenal cortex Obesity is one of the most constant findings in this disease being noted in 97 per cent of all cases The appetite stimulating effect of the corticord hormones undoubtedly contributes to the development of this obesity There is a characteristic distribution of the fat It is most prominent in the upper part of the body, the cheeks, supraclavicular and neck regions over the spines of the upper vertebral column, and the trunk The appearance of the patient has given rise to the descriptive term 'buffalo obesity" However, some cases show pseudoobesity, that is, the characteristic obesity of the upper part of the body is apparent, although there is no abnormal increase in the total body weight [90]

Undernutrition in a verified case of Cushing's disease resulted in a loss of weight exactly as predicted for a normal person This led Freyberg and Newburgh to conclude that

tilism genital dystrophy and adiposity in the presence of a tumor at the base of the brain [25] On the basis of his description the condition of untold numbers of fat children had been diagnosed as Frohlich s syndrome and they have been subjected to courses of hormonal therapy The normal development of puberty belies the diagnosis in most of these youngsters As a descriptive term "Frohlich s syndrome can be accepted However there is no evidence to prove that obesity and distribution of fat in this disease are caused by hypofunction of the anterior pituitary Frohlich himself admitted in 1940 that the obesity in his original case was secondary to hypothalamic damage caused by the tumor rather than by any destruction of the pituitary itself Hetherington has shown that no amount of pituitary damage will cause obesity if the hypothalamus is intact [54]

Simmond s disease is a process associated with failure of the anterior pituitary Individuals with this disease are often thin and cachectic Thus we have the situation in which the obesity of Frohlich s syndrome and the cachexia of Simmond s disease are attributed to the same dysfunction of the pituitary gland

Cushing's disease is an endocrinopathy which is usually associated with obesity This is probably mediated through adrenal cortical hormones and will be discussed further under that heading

The ability of posterior pituitary extract to cause a decrease of the neutral fat in the blood and to prevent a rise of blood lipids following a fatty meal led Raab to postulate a fat regulating center in the hypothalamus In dogs destruction of the tuber cinereum or interruption of the nervous pathways between the hypothalamus and the liver re

tolerance after weight loss If the excess weight were regained diabetes again developed, only to disappear a second time after satisfactory weight reduction When the weight of these patients was normal, glycosurea was not present even though they were under no restrictions or treatment These authors postulated that excess fat in the liver interfered with normal glycogen formation [82, 83] The development of diabetes was related to the duration of the obesity, and not its extent A recent study utilizing liver biopsies confirmed pathologically abnormalities of the liver in all of 20 individuals who were 50 to 100 per cent overweight The severity of the lesion was directly related to the duration of the obesity [131]

The excess of insulin required for the deposition of fat in the obese may also contribute to the relative hypoinsulinism and decreased carbohydrate tolerance

Findings relevant to carbohydrate metabolism in obesity are variable and contradictory Some cases of obesity are associated with hyperinsulinism However, it has been noted that functional hyperinsulinism is frequently associated with psychoneurotic disorders A correlation between the duration and activity, that is, dynamic or static, of the obesity and an increase in glucose tolerance has been suggested In a study of two groups of obese women, one representing active," and the other "static' obesity, Beaudoin and co workers found that the former had a markedly increased tolerance to carbohydrate after ingestion of meals and after test doses of glucose [8]

Summary

The preceding chapters dealing with the etiology of obesity started with the premise that the immediate cause of the condition was a chronic disproportion between the intake

there was a normal energy exchange, and no unusual metabolic feature was apparent as a cause of the obesity [38]

Pancreas

The pancreas, through its hormone insulin, exerts a profound effect upon the intermediary metabolism of fats and carbohydrates (Chapter 2) Insulin is also required for lipogenesis (Chapter 3) Prolonged administration of protamine zinc insulin to rats has produced hyperphagia and obesity However, regular insulin has not had this effect [70]

Recently, another hormone of the pancreas which causes hyperglycemia has been identified (glucagon) An excessive production of this hormone has been suggested as one of the causes of the obese hyperglycemic syndrome in mice Increased secretion of the hyperglycemic factor would in turn cause an increase in insulin secretion, hence an increase in lipogenesis [78] *

Obesity in some individuals has been attributed to a low blood sugar, or an increased tolerance to carbohydrates as manifested by a flat glucose tolerance curve, or one with a pronounced dip in the level of blood sugar after several hours It is argued that a low concentration of blood sugar is a stimulus to the appetite However, the usual finding in obesity, especially in the middle aged, is a *decreased* carbohydrate tolerance Diabetes is much more frequent in obese persons It is almost axiomatic that an obese individual who develops diabetes after the age of 45 will not require insulin if he loses his excess weight

Newburgh and Conn found that two thirds of persons between the ages of 30 and 65 admitted to their diabetic clinic were overweight. Thirty five patients were followed. All except one showed reversion to a normal carbohydrate

* A great many more recent studies fail to support this concept

CHAPTER 10

Obesity in Childhood

For some reason, obesity in childhood is frequently considered apart from the problem in general Special classifications, etiologies, and methods of treatment have been advocated for this group

It is true that certain modifications in the general plan of treatment must be made because of different nutritional requirements necessitated by the need for maintaining growth and development (see section on management), but we do not feel that any fundamental differences exist between obesity in children and adults

It is unfortunate that the obese child is often considered an endocrine problem Rony, who found only 13 frank endocrinopathies in 200 obese adults, stated there were definite endocrine abnormalities in 34 of 50 obese children [98] Why this discrepancy should exist is difficult to understand Most obese children live to adulthood, and, if endocrine factors are responsible for their obesity while young, why are they not the same in adult life? If there is such a high incidence of spontaneous cure of endocrine abnormalities, the problem has been magnified out of all proportion to its importance

Obesity in children probably does not differ from that

and output of energy An attempt to explore possible ab normalities responsible for this disproportion has failed to reveal any consistent differences between obese and normal individuals as regards genetic, metabolic, or endocrine factors Contradictory results have been reported, and contra dictory conclusions from similar data were derived by dif ferent investigators

Recently the question has been raised as to whether obes ity per se is a disease entity, or merely a symptom of a vari ety of abnormalities differing both etiologically and path ologically [45, 78] It has also not been established what effects such factors as the duration of the obesity, or its dynamic status (active or static) may have on metabolism

It is possible that the ultimate cause of the energy imbal ance may be any one or a combination of several factors such as (1) disturbances in carbohydrate metabolism, medi ated through abnormalities in the enzyme systems or through some endocrine imbalance involving the pancreas pituitary adrenal system, the thyroid, or gonads, (2) in creased lipogenesis or impairment of fat mobilization (3) inactivity, (4) disturbances in the central nervous system, probably hypothalamic in origin, (5) psychosomatic factors, operating either through the autonomic nervous sys tem or at the cortical level, (6) genetic factors [78]

CHAPTER 11

Management: General Considerations

SINCE THE cause of obesity is always an imbalance between the caloric intake and energy output or as stated differently, a state of positive caloric balance, the principle of treatment becomes obvious In simplest terms, it implies correcting this caloric imbalance There must be instituted a state of negative caloric balance during the stage of active weight reduction Following this, the patient must be trained to live in isocaloric balance so that the excess weight is not regained

A state of negative caloric balance can be accomplished by either increasing the energy output, decreasing the caloric intake, or both

PSYCHOLOGICAL FACTORS IN THE PATIENT

Overeating as an outlet for psychic stress is well recognized However some individuals react in exactly the opposite fashion Worrying oneself thin is more than just a saying Anorexia nervosa is a disease of emotional tension, but its manifestations are completely different from obesity It is obvious that overeating is not the only outlet for emotional conflicts However, to some individuals, eating as an outlet becomes a fixed habit pattern It is this habit

observed in older age groups Talbot stated that over 95 pe cent of such cases were caused by simple overeating [115] In his group the cases of obesity associated with menta retardation and other bodily defects, such as seen in the Laurence-Moon-Biedl syndrome, or those caused by hypoglycemia were rare He also stated that it was unusual to find an associated hypothyroidism, since the appetite appeared to be diminished in proportion to the lowered metabolic level Slow growth and/or mental retardation, an invariable accompaniment of diminished thyroid activity in childhood, was not apparent in most obese children Bruch has demonstrated the difficulties attendant upon determining the basal metabolic rate for children She did observe that there was no relationship between the level of blood cholesterol and the basal metabolic rate in obese children Thyroid administration and withdrawal did not influence either the serum cholesterol level or the rate of loss of weight [24]

In careful studies of obese children, Bruch found that their growth in stature was in excess of the average normal rate, but in harmony with the height and development of children who mature early She found that the menarche appeared early in obese girls Since the weight of normal children who mature early was higher than those who mature later, the weight of the obese patients represented an exaggeration of a normal trend [23]

It is obvious that these findings of intensive growth and early maturation are not consistent with theories which attempt to explain childhood obesity on the basis of hypothyroidism and hypopituitarism They are more in agreement with observations of the growth promoting effects of abundant nutrition

take advantage of him Too soft an attitude will soon result in many excuses but no loss of weight The patient that is honestly interested in losing weight will soon appreciate the wisdom of such an approach The individual who consults a physician for weight reduction merely to salve his own conscience that he is trying to do something for himself, but is unwilling to make any sacrifices toward that end, will not lose weight under any circumstances Of course, the physician must make every effort to enlist this patient's complete cooperation A description of the hazards of obesity will usually impress the patient with the serious nature of his condition However, if it does not there will be only a waste of the physician's time and the patient s time and money There will be no significant loss of weight

In essence a bad habit must be broken and a desirable one substituted This requires among other things a considerable amount of self discipline The patient must realize that although the physician can give him some help, he must do most of the work himself Will power cannot be administered in capsules

The role of the physician and the importance of return visits at regular intervals are illustrated by the comments of a patient who also happened to be a psychiatrist She admitted frankly that she was overweight because of the use of an improper diet She also stated that she did not need a physician to prescribe a diet, as dietitian colleagues could do that equally well As a physician, she had access to any medication she might desire Her objective in placing herself under treatment was to have someone to whom she was responsible It gave her someone to impress Since another would be aware of her short comings should she not lose weight as anticipated, she made every effort to be a

pattern which must be changed Sometimes, other more desirable reactions to stress can be substituted Just as other habits, such as excessive smoking or drinking can be broken, so can abnormal eating

It is seldom necessary to resort to formal psychiatric therapy to accomplish these changes in habits A careful and sympathetic discussion and explanation of the problems involved are usually all that are needed for the patient to gain some insight into his condition

We have been rather disappointed with the results obtained in some of our patients who were referred for formal psychiatric therapy An extremely obese young woman of superior intelligence and education had a highly responsible position which necessitated her making platform appearances before large audiences She felt she made an unsightly appearance because of her weight of around 300 pounds Careful and complete endocrine studies done on two occasions revealed no significant abnormalities After almost a year of psychiatric treatment, she lost no weight at all However she was pleased with the results, because this course of treatment taught her how to live with her obesity While that was quite a commendable achievement the menace to her health and life was just as great as before therapy It was at best only partial treatment, comparable to a patient with tuberculosis who has learned to make an excellent mental adjustment to his disease, but whose disease itself remains untreated

Role of the Physician

The physician must endeavor to remain in complete control of the patient at all times He should be understanding and sympathetic, but not to the extent that the patient may

CHAPTER 12

Management: Increasing Energy Expenditure

Exercise

Exercise has always had great popular appeal as a means of losing weight Familiar to all is the middle age business man tending to corpulence who says he will have to start playing golf again However, Newburgh has shown that the energy consumed in walking one mile equals 100 calories An individual must walk about 36 miles at average speed to lose one pound of fat tissue [84, 85]

Of course, hard physical labor can result in a tremendous energy output, as much as 2000 calories or more a day in excess of basal requirements, but how practical is this as a common procedure to effect weight reduction? The physical efforts of most adults are usually fixed in rather narrow limits by their occupational commitments Any major modification of this is usually impractical, if not impossible Also, since exercise usually increases the appetite, it is of dubious value in effecting a loss of weight unless there is a concomitant, proportionate reduction in food intake There is also a real danger in imposing an increased burden upon cardiovascular, renal, and respiratory systems operating under a load of increased metabolism, perhaps even already anatomically or physiologically damaged.

model patient During her period of regular revisits, she had a satisfactory rate of loss of weight When circumstances made it impossible for her to continue regular visits for an extended period of time, her rate of loss dropped precipitously Upon resuming regular supervision, this returned to its previous level She stated she realized the importance of the diet, but in the absence of supervision, a certain incentive was lacking Dietary lapses became more frequent The excuses she manufactured, which were not acceptable to her physician while she was under supervision were readily accepted by her In short there was a breakdown of the discipline that is so essential to successful reduction of weight

Some patients will question the need for frequent revisits They cannot understand why they should return when nothing new is done for them They feel that since the primary therapy is the diet, why can t they be permitted to follow it by themselves? The above illustration is the answer to that question They usually will not It must be carefully explained to such patients that if they are sincere about wanting to lose weight, constant supervision will effect a much more rapid attainment of a desirable weight, and will be less costly in the long run Several patients who discontinued their visits returned and admitted the wisdom of and necessity for constant supervision

function The basal metabolic rate in obesity is normal when calculated for the actual weight of the individual [107, 113]

More recently, thyroid has been used as a metabolic stimulant to try to *burn up* excess fat The consistent, predictable effect of thyroid in increasing metabolism is well known in myxedema Relatively small doses are sufficient to bring about this effect Usually no more than two to four grains of thyroid daily is required to maintain an euthyroid state after total ablation of the thyroid gland *Actually, hypothyroid patients are relatively intolerant to thyroid medication*

The calorigenic effect of thyroid in the euthyroid individual, however, is not so certain In a long range experiment, Johnston, Squires and Farquharson studied the effect of increasing increments of thyroid [57] They found that it was extremely difficult to bring about a permanent elevation in the basal metabolic rate On a dose of two grains a day, there was an early rise in the basal metabolic rate, then a gradual fall When the dose was increased to four grains daily the metabolic rate again rose, on prolonged administration it again fell but not to the original level A few instances of toxicity were noted On six grains daily, there was again an increase in metabolic rate This again declined, but became stabilized above the control level Toxic symptoms were frequent At this dosage level, some subjects began to lose weight Those who did suffered from increased fatiguability, malaise, and palpitation

When thyroid was discontinued, the above workers noted that there was quick relief of toxic symptoms However, there was also a rapid drop in the basal metabolic rate indicating that the thyroid gland was depressed, probably

While activity alone cannot be the entire solution to the problem of obesity moderate exercise should be en couraged as part of the reducing regimen Although it is unreasonable to ask an individual to walk 36 miles to lose one pound walking one mile a day a not too difficult task will result in an expenditure of energy equivalent to ten pounds of fat in a year Similarly regular indulgence in other forms of activity and sports to a reasonable extent can result in the expenditure of a considerable amount of caloric equivalents when calculated on a long term basis *provided there is no simultaneous increase in the amount of food eaten* [78 118]

Exercise is also of great value in creating a feeling of well being maintaining muscle tone and helping take up loose skin

Drugs

Several drugs are reputed to cause an increase in the metabolic rate thereby resulting in the consumption of excess tissue Dinitrophenol is one of these However the high incidence of serious toxic effects such as agranulocytosis cataracts neuritis and skin rashes makes its use ex tremely hazardous and it should never be employed

Thyroid hormone has enjoyed great popularity as a weight reducing agent for many years Originally it was thought that diminished thyroid activity was a frequent cause of obesity and therefore the administration of the thyroid hormone would act as a specific remedy in correct ing this However more recent studies have demonstrated that hypothyroid and even myxedematous patients are not necessarily obese indeed they may be underweight [100] Conversely most obese individuals have normal thyroid

that this drop in basal metabolic rate does not appear if the diet contains an adequate amount of protein [125] We have noticed no significant change in the basal metabolism of patients successfully losing weight on a low calorie diet containing 75 Gm of protein a day [39, 41, 42]

We do not mean to imply that thyroid should not be used when indicated It certainly should be prescribed for obese patients who are also hypothyroid However, it should be realized that its use is to correct a coincidental disease, just as digitalis or insulin would be used where indicated rather than as a specific treatment for the obesity itself

because of an inhibition in the formation of the thyrotrop hormone of the anterior pituitary Fortunately, this depre sion was only temporary, and there was a return to contr levels in about two to six months

There was great individual variation in the tolerance t thyroid among euthyroid individuals found in the abov studies Some could not tolerate three grains a day, whil one patient noticed no ill effects while taking ten grains day This latter patient, incidentally, gained weight whil taking such an enormous dose of thyroid [57]

The effect of thyroid on loss of weight in the norma person is inconstant and unpredictable When it does occur it is apparently secondary to the toxic effects of the drug

As a result of these studies, it is obvious that there is no indication whatsoever for the routine use of thyroid in the management of obesity There is no physiological basis for its employment, since hypothyroid persons are not neces sarily obese, nor are obese individuals with rare exception, hypothyroid Although the basal metabolic rate of obese patients is normal when calculated for their actual weight, computations based upon their ideal weight indicate that their energy output is high Thus, not only is thyroid in effective in moderate dosage, but potentially extremely dangerous when used in sufficiently large dosage to cause weight reduction since such action is mediated through its toxic effects After an extensive trial, and except in cases with proven hypothyroidism we have abandoned the use of thyroid at our clinic for the simple reason that it is

subjects on a diet of 444 calories per day, containing 0 9 Gm of protein per Kg of ideal body weight These patients remained in nitrogen equilibrium, felt well, and retained their usual vigor No ketosis developed in spite of an average weight loss of 21 Kg in 100 days [110, 111]

Such extreme restrictions of calories, however, can only be attained in a hospital, where all portions of food are weighed and measured It is not necessary to enforce so marked a deprivation of food in the clinical management of the average case of obesity

What other factors aside from total calories must be given consideration? The diet must (1) contain an adequate amount of protein (1 Gm of protein per Kg of *ideal* weight is satisfactory), (2) contain sufficient carbohydrate to act as a protein sparer and to prevent ketosis, (3) be adequate in minerals and vitamins, or such deficiencies should be made up by supplements and (4) be acceptable to the patient It is useless to try to force on an individual foods that are repulsive to him

The second important function of a diet is to teach the patient proper eating habits This is every bit as important as effecting a loss of weight and is much more difficult to ccomplish Of what avail is it to have a patient lose 40 ounds in six months only to have him regain it three onths after supervision is discontinued? Yet this happens all too frequently because this very important function of dietotherapy is not taken into account The patient becomes obese because he ate improperly If this is not corrected through re education, any reducing regimen is doomed to failure, since the aim of both the physician and patient should be not only the elimination of obesity, but the maintenance of a desirable weight

CHAPTER 13

Management: Decreasing Energy Intake (Diet)

SINCE ACCOMPLISHING weight reduction by increasing the energy output is not only ineffective and impractical, but may even be dangerous, the management of obesity, for the most part, must be concerned with the reduction of caloric intake through proper dietary regulation There is considerable controversy as to the type of diet both qualitatively and quantitatively that will best accomplish a reduction of weight Evaluation of some of the problems involved may help to clarify our own position

FUNCTIONS OF A DIET

What are the functions of a weight-reducing diet? (1) The patient should lose weight, and (2) he should establish proper eating habits lest the weight be regained after termination of treatment

FACTORS INVOLVED IN PLANNING A DIET

In order to effect a loss of weight, the diet must provide less calories than the individual expends How much less depends upon how rapid a loss of weight is desired The caloric intake can be reduced to extremely low levels with safety Strang, McCluggage and Evans observed a group of

subjects on a diet of 444 calories per day, containing 0 9 Gm of protein per Kg of ideal body weight. These patients remained in nitrogen equilibrium, felt well, and retained their usual vigor No ketosis developed in spite of an average weight loss of 21 Kg in 100 days [110, 111]

Such extreme restrictions of calories, however, can only be attained in a hospital where all portions of food are weighed and measured It is not necessary to enforce so marked a deprivation of food in the clinical management of the average case of obesity

What other factors aside from total calories must be given consideration? The diet must (1) contain an adequate mount of protein (1 Gm of protein per Kg of *ideal* weight satisfactory), (2) contain sufficient carbohydrate to act as a protein sparer and to prevent ketosis, (3) be adequate in minerals and vitamins, or such deficiencies should be made up by supplements, and (4) be acceptable to the patient It is useless to try to force on an individual foods that are repulsive to him

The second important function of a diet is to teach the patient proper eating habits This is every bit as important as effecting a loss of weight and is much more difficult to accomplish Of what avail is it to have a patient lose 40 pounds in six months only to have him regain it three months after supervision is discontinued? Yet this happens all too frequently because this very important function of dietotherapy is not taken into account The patient becomes obese because he ate improperly If this is not corrected through re-education, any reducing regimen is doomed to failure, since the aim of both the physician and patient should be not only the elimination of obesity, but the maintenance of a desirable weight.

It is to accomplish this purpose that we use and advocate a general diet, made up of ordinary everyday foods with an average distribution of proteins, carbohydrates, and fats It encourages cooperation by the patient since the adjustment he has to make is only quantitative, not qualitative also Patients who are sincere about wanting to lose weight make this adjustment readily in about three to five weeks Thereafter, the problem of dietary adherence is not too great When satisfactory weight reduction has been accomplished, a firm foundation has been laid for the maintenance of proper eating habits Adjustment of this basic diet by the addition of sufficient foods to make it isocaloric is simple for the physician and patient and places no additional strain upon the patient

Many types of diet combinations have been advocated the proponents of each proclaiming its superiority Aside from a few which are faddist and nutritionally inadequate most diets are satisfactory, and will accomplish one of the functions of a diet that is, a loss of weight But will the patient develop proper eating habits?

High Protein Diet

The high protein diet is probably the most popular of the special type diets It was originally advocated to take advantage of the presumably greater specific dynamic action of protein foods The specific dynamic action of protein is 30 per cent, as compared to 6 per cent for carbohydrate However, the 30 per cent applies to the ingestion of protein only Even high protein diets contain some carbohydrate and fat It is almost impossible to separate these elements from protein since they coexist in the natural state of foods The

specific dynamic action of an average meal is about 9 per cent Thus caloric savings accruing to the high protein diet will be about 150 calories a day a relatively insignificant amount when compared to the caloric deficit in a usual reducing diet Some disadvantages of a high protein diet more than outweigh these slight energy savings It is what might be termed an unnatural diet The average individual does not ordinarily eat meat three times a day nor is he accustomed to consuming large numbers of eggs These foods are the essentials of the usual high protein diet As a result the diet soon becomes monotonous and unpalatable in addition to being rather costly Since it is unacceptable to the patient it is extremely difficult to maintain his co operation

Even if the patient has exceptional will power and adheres to the diet long enough to reach a desirable weight what is the next step? The actual reduction of weight is but a part of the treatment The maintenance of this low weight is equally if not more important It is unreasonable to expect an individual to exist on an unnatural diet for the rest of his life On the other hand it is difficult to return him to the usual type of mixed diet for the only one he knows is the one that resulted in his obesity Consequently the early use of the high protein diet means starting all over at the end of the reducing period and then teaching him what a properly balanced diet is and how to use it. Is it not more sensible to use a low caloric mixed diet at the outset? Then when the desired weight is reached no drastic change is necessary and the transition from hypocaloric to an isocaloric diet is made easily and smoothly with little additional effort on the part of the patient

Protein Powders

These are widely advertised for use in weight reduction with the recommendation that they be used in place of meals, or sprinkled on food It is thus anticipated that the high specific dynamic action of the protein will in some way cause a consumption of excess fat As has been shown the specific dynamic effect of food is a small factor in the total energy exchange

We studied the effects of one of these preparations in the following experiment Alternate patients were assigned to one of two groups A 1200 calorie diet was prescribed for the patients in one group The patients in the other group were given a protein powder preparation They were instructed to use two teaspoonsful of this powder dissolved in water for breakfast and lunch, eating nothing else for those two meals No restrictions were placed on their dinner or evening meal It was found that there was practically no difference in the rate of weight loss between the two groups

The experiment was then modified as follows No change was made for the group that received the 1200 calorie diet The other group continued to use only the protein powder for breakfast and lunch However, a diet was prescribed for their dinner This diet was calculated to contain the difference between the calories contained in the powder used for breakfast and lunch and 1200 calories Thus their total daily intake was also 1200 calories When the caloric intake of this group was also controlled, a slightly greater rate of weight loss than that attained by the control group ensued. The average weekly weight loss for the control group was 0 9 pounds, while that of the group using the protein powder was 1 2 pounds (Table 5) However, 38 per

TABLE 5 THE RATE OF LOSS OF WEIGHT OF A GROUP OF PATIENTS RECEIVING A 1200 CALORIE DIET COMPARED TO A SIMILIAR GROUP RECEIVING A PROTEIN POWDER PREPARATION FOR BREAKFAST AND LUNCH, AND A DIET FOR DINNER TO ALLOW A TOTAL DAILY CALORIC INTAKE OF 1200 CALORIES

	1200 Calorie Diet Alone	*Protein Powder Plus Food to Make 1200 Calories*
No of patients	15	13
verage time observed (wks)	13	8 1
verage weight loss (lbs per wk)	0 9	1 2
cidence of side effects (%)	0	38

cent of the patients who used the protein powder complained of unpleasant side effects These side effects were almost exclusively referable to the gastrointestinal tract and consisted of gastric irritation, nausea, vomiting, and constipation [39]

These studies indicate that protein powders are most effective in conjunction with dietary restrictions, but are at best only slightly more effective than diet alone Is there then any distinct advantage in the use of such preparations? A few teaspoonsful of a rather unpleasant tasting powder is hardly a satisfactory substitute for even a small meal An indication of patient resistance to such preparations is that a considerably larger number of individuals in this group as compared to the control group did not return to the clinic Furthermore, the appearance of undesirable side effects in 38 per cent of the patients using this preparation was excessive It is bad enough that a patient on a reducing regimen must suffer some discomfort from hunger Cooperation can hardly be expected when he is subjected to additional unpleasant symptoms

A further problem arises in conjunction with the use of protein supplements Should the weight loss be satisfactory how is the patient to maintain it? He certainly cannot be expected to substitute an unpalatable powder for food for the rest of his life Moreover he has received no training in proper eating habits Since dietary restriction in addition to the use of protein powders is required for optimum results it is no more difficult for the patient if a general low caloric diet is prescribed for all his meals

High Fat Diet

Recently Pennington has advocated a diet high in fat content and low in carbohydrate foods—less than 20 Gm per meal [88 89] According to this diet about 80 per cent of calories should be derived from fats and about 20 per cent from proteins Fluids are encouraged but salt is restricted

Pennington explains the physiological basis of his diet as follows In obese individuals there is a defect in the ability of the tissues to metabolize carbohydrates beyond the pyruvic acid stage The accumulated pyruvic acid inhibits the utilization of fat and thus reduces the rate of mobilization of fat from its depots Since the body is unable to use carbohydrates or fats in customary amounts a larger intake of food is necessary to serve energy needs According to Pennington much of this ingested food is rapidly converted to fat and stored in the fat depots [88]

By restricting the intake of carbohydrates the inhibitory effect of pyruvic acid is decreased The ingestion of large amounts of fat results in a mild ketonemia This ketonemia stimulates the mobilization of fat The tissues receive a considerable quota of their energy needs from the mobilized

fat which is released from depots faster than it is deposited thus resulting in a loss of weight [88]

In Pennington's regimen, there is no restriction of total calories He states that some people can reduce their weight on an intake in excess of 3000 calories a day

The difference between this type of diet and a low calorie diet is, according to Pennington, that low calorie diets limit the formation of new fat by withholding necessary materials, while his diet produces a loss of weight through increased utilization of stored fat [89]

Pennington has reported excellent results using the above therapeutic regimen However several questions arise regarding the physiological basis of this concept Does pyruvic acid inhibit the utilization of fat? If carbohydrates can be metabolized only to pyruvic acid from what is the excess amount of fat synthesized since it is probable that only those substances capable of being degraded biologically to 2 carbon fragments can be synthesized into long chain fatty acids? [47] The active 2 carbon unit is probably acetyl Co A, the next step beyond the pyruvic acid stage And finally, the effect of ketonemia on fat mobilization has not been established There have been many conflicting results and conclusions regarding ketosis in obesity (See Chapter 8)

The lack of need for restricting the intake of calories is also unusual Thus far there have been no careful studies of the dietary histories or measurements of the actual caloric intake of these patients Until such is done it is difficult to disregard the mass of evidence to the contrary

This concept of the cause and management of obesity offers a new and different approach to the problem However, until such time as the biochemical background

Table 6A Basic Reducing Diet*
(Approximately 1000 calories)

Menu Pattern

Breakfast
- 1 serving of fruit, no sugar added
- 1 egg, soft cooked, hard cooked, or poached
- ½ slice bread or toast
- ¼ cup skimmed milk (beverage)
- Plain coffee or tea

Lunch
- 2 oz lean meat or equal (see Meat below)
- ½ to 1 cup of any vegetable on List A
- ½ slice bread
- 1 pat of butter
- 1 serving of fruit
- 8 oz of skimmed milk
- Plain coffee or tea

Supper
- 3 oz lean meat or equal (see Meat below)
- ½ to 1 cup of any vegetable on List A
- ½ cup of any vegetable on List B
- ½ slice bread
- 1 pat of butter
- 1 serving of fruit
- 8 oz skimmed milk
- Plain coffee or tea

Sample Menu

Breakfast
- 4 oz glass orange juice
- 1 soft cooked egg
- ½ slice enriched bread
- Black coffee
- ¼ cup skimmed milk

Lunch
- 2 slices liverwurst
- ½ cup cole slaw seasoned with salt, pepper, and vinegar
- ½ cup stewed tomatoes
- ½ slice enriched bread
- 1 pat of butter
- 1 small pear
- 8 oz glass skimmed milk

Supper
- 1–3 oz broiled hamburger
- ½ cup canned string beans
- ½ cup raw carrot and celery sticks
- ½ slice enriched bread
- 1 pat of butter
- ½ grapefruit
- 8 oz glass skimmed milk

Meat

Two ounces of meat or substitute is equal to *one* of the following
- 2 eggs
- 2 slices of processed cheese
- ½ cup cottage cheese
- 6 medium sardines (drain off oil)
- ½ cup canned fish (drain off oil)
- 2 slices cold cut (4½" × ⅛")
- 2 frankfurters (8–9 per lb)
- 4 tbs peanut butter
- 2 oz lean meat or poultry, bones removed

Three ounces of meat or substitute is equal to *one* of the following
- 1 medium veal chop
- 1 veal cutlet (⅓" × 4" × 4")
- 2 small lamb chops
- 2 medium meat patties
- 1 slice roast meat (¼" × 4" × 4")
- 2 slices liver (3" × 2" × ⅜")
- ¼ lb fish
- ¼ chicken (broiler, *1½ to 2* lbs)
- Cold plate 1 egg, 1 slice cheese, 1 slice cold cut

Table 6A Basic Reducing Diet* (*Continued*)

Vegetable

List A

Use freely if served raw Use one cup at a meal if cooked if taken in excess of this amount calculate as a List B vegetable Limit tomatoes or tomato juice to ½ cup at one meal

Asparagus	Lettuce
Broccoli	Mushrooms
Brussels sprouts	Okra
	Peppers
Cabbage	Radishes
Cauliflower	Sauerkraut
Celery	Young string beans
Chicory	
Cucumbers	Summer squash
Escarole	Tomatoes
Eggplant	Watercress

Greens beet greens spinach collards

List B

You may use these vegetables raw or cooked ½ cup

Beets	Pumpkin
Carrots	Rutabagas
Onions	Winter squash
Peas green	Turnip

Fruit

Apple	1 small	Mango	1 small
Applesauce	½ cup	Orange	1 small
Apricots dried	4 halves	Orange juice	½ cup
Banana	½ small	Peach	1 medium
Blackberries	1 cup	Pear	1 small
Blueberries	⅔ cup	Pineapple	½ cup
Cantaloupe	¼ (6 diam)	Pineapple juice	⅓ cup
Cherries	10 large	Plums	2 medium
Grapefruit	½ small	Prunes dried	2 medium
Grapefruit juice	½ cup	Raisins	2 tbs
Grapes	12	Strawberries	1 cup
Grape juice	¼ cup	Tangerine	1 large
Honeydew melon	⅛ medium	Watermelon	1 cup

Do Not Eat

1 Sugar candy cake pie pastry ice cream cookies, nuts malteds
2 Gravies sauces fried and greasy foods salad dressings
3 Smoked meats such as ham corned beef pork
4 Sodas beer alcohol
5 Starches such as potatoes rice noodles spaghetti

* Courtesy Metropolitan Hospital Clinic

TABLE 6B BASIC REDUCING DIET*
(Approximately 1200 calories)

Menu Pattern

Breakfast
- 1 serving of fruit, no sugar added
- 1 egg, soft cooked, hard cooked, or poached
- 1 slice bread or toast
- ½ cup skimmed milk (beverage)
- Plain coffee or tea

Lunch
- 3 oz lean meat or equal (see Meat below)
- ½ to 1 cup of any vegetable on List A
- 1 slice bread
- 1 pat of butter
- 1 serving of fruit
- 8 oz of skimmed milk
- Plain coffee or tea

Supper
- 3 oz lean meat or equal (see Meat below)
- ½ to 1 cup of any vegetable on List A
- ½ cup of any vegetable on List B
- 1 slice bread
- 1 pat of butter
- 1 serving of fruit
- 8 oz skimmed milk
- Plain coffee or tea

Sample Menu

Breakfast
- 4 oz glass orange juice
- 1 soft cooked egg
- 1½ slices enriched bread
- Black coffee
- ½ cup skimmed milk

Lunch
- 2 slices liverwurst
- ½ cup cole slaw seasoned with salt, pepper, and vinegar
- ½ cup stewed tomatoes
- 1 slice enriched bread
- 1 pat of butter
- 1 small pear
- 8 oz glass skimmed milk

Supper
- 1–3 oz broiled hamburger
- ½ cup canned string beans
- ½ cup raw carrot and celery sticks
- 1 slice enriched bread
- 1 pat of butter
- ½ grapefruit
- 8 oz glass skimmed milk

Meat

Two ounces of meat or substitute is equal to *one* of the following

- 2 eggs
- 2 slices of processed cheese
- ½ cup cottage cheese
- 6 medium sardines (drain off oil)
- ½ cup canned fish (drain off oil)
- 2 slices cold cut (4½" × ⅛")
- 2 frankfurters (8–9 per lb)
- 4 tbs peanut butter
- 2 oz lean meat or poultry, bones removed

Three ounces of meat or substitute is equal to *one* of the following

- 1 medium veal chop
- 1 veal cutlet (½" × 4" × 4")
- 2 small lamb chops
- 2 medium meat patties
- 1 slice roast meat (¼" × 4" × 4")
- 2 slices liver (3" × 2" × ⅜")
- ¼ lb fish
- ¼ chicken (broiler, 1½ to 2 lbs)
- Cold plate 1 egg, 1 slice cheese, 1 slice cold cut

TABLE 6B BASIC REDUCING DIET* (Continued)

Vegetable

LIST A

Use freely if served raw. Use one cup at a meal if cooked; if taken in excess of this amount calculate as a List B vegetable. Limit tomatoes or tomato juice to ½ cup at one meal.

Asparagus	Lettuce
Broccoli	Mushrooms
Brussels sprouts	Okra
Cabbage	Peppers
Cauliflower	Radishes
Celery	Sauerkraut
Chicory	Young string beans
Cucumbers	Summer squash
Escarole	Tomatoes
Eggplant	Watercress

Greens: beet greens, spinach, collards

LIST B

You may use these vegetables raw or cooked ½ cup

Beets	Pumpkin
Carrots	Rutabagas
Onions	Winter squash
Peas, green	Turnips

Fruit

Apple	1 small	Mango	1 small
Applesauce	½ cup	Orange	1 small
Apricots, dried	4 halves	Orange juice	½ cup
Banana	½ small	Peach	1 medium
Blackberries	1 cup	Pear	1 small
Blueberries	⅔ cup	Pineapple	½ cup
Cantaloupe	¼ (6″ diam.)	Pineapple juice	⅓ cup
Cherries	10 large	Plums	2 medium
Grapefruit	½ small	Prunes, dried	2 medium
Grapefruit juice	½ cup	Raisins	2 tbs
Grapes	12	Strawberries	1 cup
Grape juice	¼ cup	Tangerine	1 large
Honeydew melon	⅛ medium	Watermelon	1 cup

DO NOT EAT

1. Sugar, candy, cake, pie, pastry, ice cream, cookies, nuts, malteds
2. Gravies, sauces, fried and greasy foods, salad dressings
3. Smoked meats such as ham, corned beef, pork
4. Sodas, beer, alcohol
5. Starches such as potatoes, rice, noodles, spaghetti

* Courtesy, Metropolitan Hospital Clinic

definitely established, caloric balance studies done, and the therapeutic results repeated and duplicated, it must be regarded more as an interesting hypothesis rather than an established fact

The Dietary Prescription

The caloric allowance of the diet is governed almost exclusively by how rapid a weight reduction is desired. However, two points must be given consideration in the ordinary clinical management of obesity It is almost impossible to maintain a diet of less than 900 to 1000 calories outside a hospital where all foods can be weighed and measured Caloric allowances in excess of 1500 calories usually result in too slow a weight loss, and the patient becomes discouraged We have employed diets of 1000 and 1200 calories Because the rate of weight loss is satisfactory when such diets are used and because variety and palatability are easily accomplished, the patient's cooperation is not too difficult to secure

Since no diet can be successful unless the patient adheres to it, the method of presentation and the instructions given to the patient are extremely important It must be remembered that eating is a pleasurable experience It must be maintained as such if continued cooperation by the patient is to be obtained Instructions encumbered by many "don ts" cannot be expected to add to the happiness of the patient Also, people enjoy eating food, not calories When each meal becomes an exercise in mathematics, the pleasures of eating are soon gone, and usually the patient also

Our patients are given a diet sheet containing the types and amounts of foods they are permitted to eat No mention is usually made of any forbidden foods unless the patient

specifically asks about them We have found this positive approach (telling the patient what he should eat) much more acceptable than the negative approach (telling him what he must not eat) Tables 6A and B illustrate basic diets that allow approximately 1000 and 1200 calories Easily made variations and additions to these diets permit any modification the physician may deem necessary for a specific case An additional slice of bread can be added for those individuals forced to eat a sandwich for lunch

TABLE 6C APPROXIMATE CONTENT OF FOOD FACTORS PRESENT IN THE BASIC 1000 CALORIE DIET

Carbohydrates	100 Gm
Proteins	75 Gm
Fats	40 Gm
Calcium	950 Gm
Phosphorus	1500 mg
Iron	11 mg
Vitamin A in excess of	5000 I U
Thiamin	1 mg
Riboflavin	2 mg
Niacin	4 5 mg
Ascorbic acid in excess of	100 mg

The content of the diets as regards proteins carbohydrates, fats, minerals and vitamins will vary somewhat depending upon what foods are selected from the different groups In general the 1000 calorie diet will allow approximately 100 Gm of carbohydrates, 75 Gm of proteins and 40 Gm of fats (Table 6C)

Several points about the dietary instructions should be emphasized. The total intake of food is divided into the three usual meals breakfast lunch and dinner The patient must not be permitted to continue with a cup of coffee for

breakfast, a sandwich for lunch, and a too big dinner Training in proper eating habits must begin at the time of the first visit It has also been demonstrated that there is a greater increase in weight when all the food is eaten at one time than when the same total quantity of food is taken in divided portions throughout the day This may be caused by an inability of the body to handle large amounts of food taken at one time, with the result that the excess is diverted to storage It has also been found that large feedings decreased specific dynamic action as compared to smaller, *more frequent feedings*

The patient is not given daily menus, as this makes for monotony Rather, he is given a choice of several foods from each group, and he can make his selection as determined by his tastes, desires, and convenience at the time of eating It is rather difficult and embarrassing to ask your hostess to prepare a special menu for you because that *is* what your diet demands for that meal

The diet must contain a sufficient variety of common, easily obtainable foods to satisfy everyone, no matter what his social or economic position may be It should be capable of being followed as well by the social lion who attends dinner parties several times weekly as by the harried business man who must grab a quick meal at whatever restaurant may be near, by the affluential as well as by those less fortunate financially

No mention is made of the caloric content of foods If the patient, as so many have, has *bought a book,* he is advised to hide it The science of dietetics is much too complex for one to expect the average person, after reading a book, to be adept at planning meals on the spur of the moment Even if the patient can master tables of caloric

values, he knows little about the qualitative differences in food values among, for example, potatoes, pie, and butter In his ignorance, he thus makes unwise substitutions in his self planned diet, with the result that such a diet frequently is nutritionally inadequate

In the diet here illustrated (Table 6), the patient is allowed free substitutions within any group, but no substitutions between groups are permitted

To re emphasize what was stated above, people like to eat food, not calories, and an exercise in mathematics offers no particular pleasure The calculations should be made by one capable of making them properly The patient should devote his energies to following the diet, rather than be called upon to plan it

Dietary Modifications for Children

As previously mentioned (Chapter 10), some modifications are made in the basic diet (Table 6) when it is prescribed for children Unless the child is grossly overweight, we do not attempt to effect an actual loss of weight Rather, our efforts are aimed at preventing a further gain in weight, thus allowing the child "to grow into" his present weight In addition, it is usually wise to prescribe supplementary vitamins, and increase the allowance of milk to one and one half pints a day It is frequently possible to allow as much as 1800 calories a day

Presentation of Dietary Instructions to the Patient

Adherence to the diet is the one essential of a reducing regimen Without it, there can be no loss of weight. The diet must be explained to the patient most carefully, and in

the greatest detail This is not the place for time saving devices The patient must be impressed with the importance and seriousness of the matter Each of the meals is discussed. The selection of foods within groups must be explained It is surprising how frequently a patient will ask, "Do I have to eat everything in that group for each meal?" This is the time to take into account individual dislikes, idiosyncrasies, and allergies The importance of some of the components of the diet, such as salads and fresh fruits for bowel regularity, and milk for its calcium content, is explained Should necessity require that any important constituent of the diet be eliminated, replacement by a proper supplement or medication must be made All questions, no matter how irrelevant or foolish they may seem to the physician must be fully and thoughtfully answered, for they are not irrelevant or foolish to the patient *Calories are not mentioned* The relative size of portions is described, using measurements and comparisons that are familiar to the patient For example, we describe the size of a portion of meat or fish as being equivalent to the size of a dollar bill and about one quarter inch thick That he will readily identify, whereas telling him a portion should be 100 Gm means nothing at all to him

Salt and fluid intake are not restricted unless some specific indication such as hypertension or congestive cardiac failure coexists We rely on the homeostatic mechanisms of the body to maintain fluid and sodium equilibrium In the presence of normal cardiac and renal functions, the body will retain what is needed and eliminate the excess Newburgh has shown that although salt and water retention may influence the day to day weight, it has little or no effect in long range experiments [84]

The patient should be given definite goals toward which he should strive Various types of food nomograms have been described With them, one can predict the rate of weight loss with remarkable accuracy—if, and only if, the measurements of food intake are made with equal accuracy If they are not, the patient's morale suffers when he discovers that his actual loss of weight is less than the predicted loss Consequently, precise, quantitative predictions of weight loss, while indispensable in metabolic studies, are of less value in the clinical management of obesity

We do not mean to imply that the patient should be allowed to drift along losing very slowly and irregularly, if at all With the above described diet the patient is told he is expected to lose an average of six to eight pounds a month Since a loss of two to three pounds a week would be realized if such caloric intakes were adhered to quantitatively, one can see that some leeway is allowed the patient The patient should also be given a longer range goal toward which to strive He is told of definite goals that he is expected to reach in a specified time For example, a patient who has weighed well over 200 pounds for some time is told that he is expected to break out of the 200 pound class by a specified date As each goal is reached, a new one is set, always using the criteria described above The goal that is set should be attainable by adherence to the diet prescribed It should not be made too easy That will cause the patient to loaf Nor should it be so difficult to reach that the patient becomes discouraged at the outset

CHAPTER 14

Management: Anorexigenic Agents

Amphetamine Preparations

A loss of weight associated with a decrease in voluntary food intake has been noticed since the earliest studies with amphetamine During the treatment of narcolepsy and depressed states with this drug, a loss of weight was observed in most of the patients [*30, 117*] Since then, there have been many reports describing the value of this drug as an adjunct to weight reducing regimens

The mechanism of appetite depression by these drugs is obscure It has been found that there is an increase in the emptying time of the stomach This is probably caused by a decreased tonus of the stomach and an increased tonus of the pylorus [*10, 119*] There *is no* apparent decrease in absorption or assimilation as the dry weight of the stool is not diminished [*114*]

However the effect of these drugs is probably not on the stomach since surgical denervation of the gastrointestinal tract does not influence the anorexia and weight loss This would suggest that the effects are central. In this regard, it it interesting to note that amphetamine did not influence the voluntary intake of food of a small group of patients who had undergone a surgical prefrontal lobotomy [*51*]

Massive doses of amphetamine were administered intravenously to dogs These animals practically starved to death, although adequate amounts of food were made available to them [51]

In most clinical studies with these drugs, they have been used in conjunction with a low calorie diet Albrecht however, claimed he was able to accomplish satisfactory reduction by the use of amphetamine alone [2] If this were so, weight reduction could be made very simple But the following is typical of what we have observed We administered an amphetamine preparation to a group of 30 patients No dietary restrictions of any kind were imposed An initial dose of 5 mg three times a day was used If this dose were tolerated, it was rapidly increased to 25 or 30 mg daily Twenty-seven patients lost weight on this regimen However, only 13 patients lost an average of one pound a week or more, the standard we had set for a satis factory rate of reduction Of these ten were under observation for a period of eight weeks or less [40]

The suggestion that satisfactory loss of weight occurred only during the early phase of treatment with amphetamine led us to examine the data for each individual more carefully During the first eight weeks, 14 patients (47 per cent) lost weight satisfactorily After ten weeks, 8 patients (27 per cent), and after twelve weeks, 7 patients (23 per cent) fell into this category Beyond this time, the number of patients averaging a weekly weight loss of one pound decreased rapidly (Fig 4)

The average weekly weight loss per subject was then cal culated for the entire group It was found that a loss of one pound per week for the entire group could be maintained for only eight weeks (Fig 5) Two possible explanations for

this can be offered The most obvious one is the development of a tolerance to the anorexigenic effect of the medication While this probably did occur, it is unlikely that it is the only factor If it were simply a matter of tolerance, the

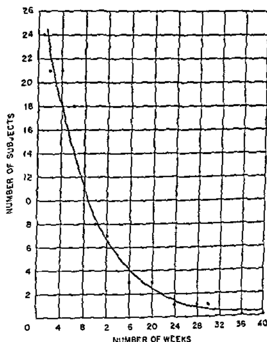


Fig 4 Number of subjects maintaining a loss of weight of one pound a week while receiving *d*-amphetamine but under no dietary restrictions (*From N Y State J Med 49* 279, 1949)

patient should return to his original caloric intake, and thus regain weight. This was not observed Rather, most of the subjects continued to lose weight, but at a decreasing rate

It has been shown on repeated occasions that the number of calories required by an individual in the basal state is

proportional to the surface area In undernutrition, there is a loss of weight to that figure which the lower caloric intake would support However, the rate of loss is not constant, but gradually decreased as the lesser weight is approached

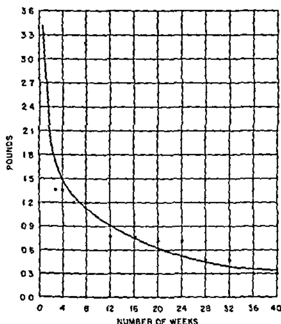


FIG 5 The average weekly weight loss per subject in 30 subjects treated with *d*-amphetamine (From *N Y State J Med* 49 279, 1949)

The curve of the rate of loss is similar to that obtained in our study

To apply these findings of the subjects in our study, let us assume that each had a daily intake of x calories at the time he entered the study The amphetamine caused a de-

crease of *y* calories a day Thus with a total intake of *x* minus *y* calories there was a gradual but decreasing rate of loss as the weight which the lessened caloric intake would support was approached

Whether the decreasing rate of loss observed in this study was caused by development of a tolerance to the medication or by an insufficient decrement in caloric intake the use of amphetamine alone even in rather large dosage was in adequate to bring about satisfactory reduction in patients more than slightly overweight Subsequent studies in which amphetamine was combined with a low calorie diet re vealed that a satisfactory rate of loss could be maintained for much longer periods [*41, 42*]

It is believed by some investigators that *d* amphetamine is superior to the racemic form as an anorexigenic agent They state that the desirable appetite depressing effects are a property of the dextrorotatory form while the undesirable excitatory effects are caused by the levorotatory form [*28*] In a small group of patients in the above study who were given both the dextrorotatory and racemic form of ampheta mine in rotation we could notice no such distinction The rate of loss and incidence of side effects were similar Sub jectively most patients did not notice any difference A few preferred the dextrorotatory form while an equally small number preferred the racemic form

The anorexigenic effects of *d* amphetamine were studied in some detail All the patients in this experiment were given a similar diet which allowed 1000 calories a day Each patient was then observed for a period of six to eight weeks while taking a placebo and a similar period of time while taking *d* amphetamine Patients were rotated as to which was prescribed initially Thus each patient served as his or

her own control. These patients were markedly obese, the entire group averaging 45 to 50 per cent above standard weight It was found that with *d* amphetamine, the average weekly loss was about twice that observed with placebo (Table 7) [*41*, *42*]

TABLE 7 COMPARISON OF AVERAGE WEIGHT LOSS OBSERVED WITH A PLACEBO UNMODIFIED *d* AMPHETAMINE,* AND SUSTAINED-RELEASE *d* AMPHETAMINE*

Medication	*No of subjects*	*No of trials*	*Average time observed (wks)*	*Average weight loss (lbs per wk)*
Placebo	64	64	6 0	0 6
Unmodified *d* amphetamine	103	118	7 1	1 2
Sustained release *d*-amphetamine	104	104	6 2	1 2

* The total daily dosage of each *d*-amphetamine preparation was 15 mg

These results require some explanation We do not mean to imply that patients lost weight more rapidly when *d*-amphetamine was used because of any direct effect of the drug It is obvious that the rate of loss should have been the same with either medication if the prescribed diet had been followed equally well. This study was carried out on a group of clinic patients, where cooperation as far as adherence to the diet was not ideal Consequently, it is felt that the more rapid rate of weight loss while using *d* amphetamine was caused by an anorexigenic effect of this drug thus making it easier for the patient to adhere more closely to the diet as prescribed

All the patients were carefully checked for objective and subjective evidence of side effects The blood pressure and pulse rate were determined at each visit, and blood counts,

urinalyses, and determinations of the basal metabolic rate were done on a representative group while on each of the medications No change in any of these attributable to *d*-amphetamine was found (Table 8) This group included

TABLE 8 AVERAGED LABORATORY AND CLINICAL DATA ON THE SAME SUBJECTS WHILE USING A PLACEBO UNMODIFIED *d* AMPHETAMINE AND SUSTAINED-RELEASE *d* AMPHETAMINE

			Average			
Medication	*Blood pressure*	*Pulse rate*	*HB (Gm)*	*WBC*	*Polys (%)*	*BMR*
Placebo	137/85	83	13 8	8390	57	+5 2
Unmodified *d*-amphetamine	137/86	81	13 6	8340	55	+5 1
Sustained release *d*-amphetamine	136/85	83	13 5	7810	55	+5 3

some patients with a marked hypertension, systolic and diastolic At first, *d* amphetamine was prescribed with caution to such patients Subsequent observations led us to use this drug without hesitation At no time did we observe any deleterious effect upon the hypertension Actually, in many instances when loss of weight was satisfactory, the level of the blood pressure declined, the usual observation when excess weight is lost

Although it has been found that amphetamine causes a slight rise in the metabolic rate, this effect is transient There is no cumulative effect of this drug

Subjective symptoms occurred in about 17 per cent of the patients using *d* amphetamine These consisted of excitatory effects such as insomnia, nervousness, and palpitation, and mild gastrointestinal disturbances such as nausea and epi

gastric distress (Table 9) In moderate dosage (up to 15 mg daily) these subjective symptoms were mild and usually easily controlled by mild sedation Only rarely was it necessary to adjust the dosage of this drug downward, or to discontinue it

TABLE 9 INCIDENCE OF SIDE EFFECTS OBSERVED IN PATIENTS USING A PLACEBO, UNMODIFIED *d*-AMPHETAMINE,* AND SUSTAINED-RELEASE *d* AMPHETAMINE*

	Placebo	*Unmodified* d-*amphetamine*	*Sustained-release* d-*amphetamine*
No of patients	64	103	104
Character and frequency			
Epigastric distress	3	9	8
Nervousness	1	11	5
Insomnia	1	2	2
Dizziness	0	3	4
Headache	0	1	1
Palpitation	2	2	0
Constipation	0	2	3
Nausea and vomiting	0	0	1
Total†	7	30	24
No of patients with side effects	6 (9%)	18 (17%)	15 (14%)

* The total daily dosage of each *d*-amphetamine preparation was 15 mg
† The discrepancy between the total number of side effects and the number of patients with side effects is due to the fact that each of several patients had multiple side effects

The action of a single dose of *d* amphetamine persists for a relatively short time Consequently, this drug must be taken several times during the day in order to be effective We have found that this drug exerts its optimal anorexigenic effect if taken 20 to 30 minutes before each meal. Although the appetite is depressed for the ensuing meal, there are periods during the day when the drug effect is absent This

results in a feeling of hunger by the patient He may then indulge in food thus exceeding his prescribed caloric allowance

Recently a sustained release *d* amphetamine preparation has been made available It consists of a capsule containing many small pellets of *d* amphetamine Each pellet is individually coated The coatings are designed to disintegrate at varying times in the gastrointestinal tract Thus the entire daily dose can be incorporated into one capsule and because of the gradual disintegration of the capsule and continuous absorption of the medication a sustained therapeutic effect can be maintained during the entire day The advantages of such a preparation are the convenience of a single daily dose and the avoidance of periods of no drug effect

Although such a preparation seemed superior to ordinary *d* amphetamine theoretically two important questions remain to be answered Would such a preparation be as effective as ordinary *d* amphetamine as an anorexigenic agent and would any increase in undesirable side effects be caused by the maintenance of a continuous drug effect?

To answer these questions a group of patients was observed while taking ordinary *d* amphetamine sustained release *d* amphetamine and a placebo Again each patient was observed while using each of these drugs thus serving as his or her own control The diet remained constant during the entire study for each patient *It was found* that the average weekly rate of loss of weight was similar while using either *d* amphetamine preparation and about twice that observed when a placebo was employed There was noted no increase in undesirable side effects when the sustained release form was used (Tables 7 8 9) Sub-

jectively most of the patients preferred the sustained release preparation because of the convenience of a single daily dose and avoidance of periods of hunger especially during the late afternoon A preparation consisting of 15 mg. of d amphetamine so constituted as to allow a gradual release and absorption of the drug over a period of eight to ten hours was found to give the optimal results with a minimum of side effects [41 42]

Addiction to Amphetamines

Addiction to amphetamine preparations has been reported [101] This is rare and occurs almost exclusively in psychopaths Some of our patients have been given such preparations for extended periods of time a year or longer In no instance have we observed any addiction to this group of drugs in the dosages prescribed or any untoward symptoms when such drugs were discontinued

Methamphetamine (Desoxyephedrine)

Methamphetamine was developed in Germany during World War II and was used there as amphetamine was used here at the time mainly as a stimulant It was reputed to be the drug used by the Luftwaffe early in the war to enable them to perform so well

Pharmacological studies of the drug here revealed that methamphetamine had about twice the stimulatory effect of amphetamine (6 mg of the former equivalent to 10 to 15 mg of the latter) Its appetite-curbing effect was about the same as that of amphetamine milligram for milligram The conclusion was that methamphetamine was more toxic than amphetamine [56]

Methamphetamine has been used extensively as an anor

exigenic agent and there have been several favorable reports concerning its action [31] In our hands, this drug has not yielded favorable results In an experiment set up in an identical fashion to our studies of amphetamine (see above), we found that there was no difference in the rate of loss of weight between methamphetamine and a placebo (Table 10) Thirty four per cent of our patients developed

TABLE 10 COMPARISON OF WEIGHT LOSS ATTAINED WITH METHAMPHETAMINE AND A PLACEBO

		Methamphetamine			*Placebo*		
*Group**	*No of subjects*	*No of trials*	*Av time observed (wks)*	*Av weight change (lbs per wk)*	*No of trials*	*Av time observed (wks)*	*Av weight change (lbs per wk)*
I	27	30	6 2	−0 5	27	6 1	−0 8
II	14	14	5 7	−1 2			
III	9				9	5 3	−0 9
Average of all trials		44	6 0	−0 7	36	5 8	−0 7

* Group I Patients observed while using methamphetamine and a placebo
Group II Pat ents observed only while using methamphetamine
Group III Patients observed only while using a placebo

side effects on a dosage of 2 5 mg three times a day When the dose was increased to 5 mg three times a day, 58 per cent of the subjects reported unpleasant reactions (Table 11) Methamphetamine in the dosage employed had no significant effect upon the blood pressure or pulse rate Four subjects had a significant elevation of their basal metabolic rate while taking methamphetamine Because of their failure to lose weight, and the high incidence of side effects considerable patient resistance to this medication was encountered during this study [39]

TABLE 11 SIDE EFFECTS NOTED WHILE USING METHAMPHETAMINE

Total no of subjects	41
Character and frequency	
Dizziness	13
Headache	9
Nausea vomiting epigastric distress	7
Somnolence and listlessness	6
Palpitation	3
Insomnia	1
Nervousness	1
Constipation	1
Total	41
No of patients with multiple symptoms	12*
Total no of patients with side effects	24 (58%)
No of patients with side effects while taking 3 tablets daily	14 (34%)
No of patients who developed side effects when dosage increased to 5 tablets daily	10 (24%)

* Consists of 1 patient displaying 4 symptoms 3 patients with 3 symptoms and 8 patients with 2 symptoms

DISCUSSION AND USE OF ANOREXIGENIC AGENTS

It has been stated that the amphetamine preparations act as placebos, and that their effect is largely psychological [29] We find it difficult to accept this on the basis of our studies We attempted to eliminate psychic influences by having each patient serve as his or her own control The patient never knew what medication was being administered at any given time We invariably found a statistically significant greater rate of loss of weight when an amphetamine preparation was used than when an identically appearing placebo was used

Amphetamine preparations have a place in the management of obesity When an individual is required to change eating habits to which he has conformed for years to a diet allowing less calories some discomfort, both physical and

ment of Simmonds' cachexia Such preparations have also been used in the therapy of Frohlich's syndrome

The idea of using similar preparations for the treatment of opposite conditions apparently caused by similar pathology is rather confusing

Posterior Pituitary

Raab, experimenting with dogs, postulated a fat regulating center in the hypothalmus, the function of which depended upon a normal supply of the posterior pituitary hormone He found that the subcutaneous injection of pituitrin caused the disappearance of neutral fat from the blood [94] Blotner, quoted by Werner [129], found that the injection of posterior pituitary extracts prevented a rise, or caused a decrease in the plasma cholesterol levels following a fat meal consisting of 500 cc of 20 per cent cream

Werner [129], on the basis of these findings, has used pituitrin for the treatment of obesity He cites a series of 77 patients treated with pituitrin and thyroid (one to three grains daily) These patients were on diets which allowed 1350 to 1500 calories a day The average duration of treat

tained with the use of diet and amphetamine, and indicates that pituitrin is certainly not a specific We used pituitrin in a small group of cases Several of these patients lost weight satisfactorily However, our enthusiasm was rather d when we found that those patients who lost pituitrin did just as well with a saline placebo ntly, those patients in our series who did well

did so because of the adherence to the diet, rather than because of any effect of the pituitrin

Sex Hormones

Both estrogens and testosterone have been suggested for the treatment of obesity While many women date the onset of their obesity to the menopause, this does not mean that there is any causal relationship between obesity and cessation of ovarian function Estrogens cause retention of sodium and water, hence a temporary gain in weight will ensue Testosterone will cause nitrogen retention Consequently, it has been advocated for use in the treatment of underweight It can hardly be expected that it is effective for both leanness and obesity

11-Oxycorticoids

From observations made during the past five years on approximately 30 obese patients there are two groups which will probably respond to treatment with a *rigidly observed diet* and an 11 oxycorticoid Here we must place those individuals with familial lipodystrophy and those who, because of ovarian dysfunction show a distribution of fat mainly to the lower abdomen, hips thighs, and legs In both of these groups it is quite common to have the patient tell you that no matter how hard she tries to maintain a diet, the end result is always the same—loss of weight in the thinnest parts of the body, with little, if any, change in the lower abdomen, hips, and legs These are the people who look thin and haggard about the face and neck following the loss of a few pounds, but who never appear rid themselves of weight below the waistline

ment of Simmonds' cachexia Such preparations have also been used in the therapy of Frohlich's syndrome

The idea of using similar preparations for the treatment of opposite conditions apparently caused by similar pathology is rather confusing

Posterior Pituitary

Raab, experimenting with dogs, postulated a fat regulating center in the hypothalmus, the function of which depended upon a normal supply of the posterior pituitary hormone He found that the subcutaneous injection of pituitrin caused the disappearance of neutral fat from the blood [94] Blotner, quoted by Werner [129], found that the injection of posterior pituitary extracts prevented a rise, or caused a decrease in the plasma cholesterol levels following a fat meal consisting of 500 cc of 20 per cent cream

Werner [129], on the basis of these findings, has used pituitrin for the treatment of obesity He cites a series of 77 patients treated with pituitrin and thyroid (one to three grains daily) These patients were on diets which allowed 1350 to 1500 calories a day The average duration of treatment was 4 6 months, and the average weight loss was 30 3 pounds, an average weekly weight loss of about 1 5 pounds This is not significantly different from the results we obtained with the use of diet and amphetamine, and indicates that pituitrin is certainly not a specific We used pituitrin in a small group of cases Several of these patients lost weight satisfactorily However, our enthusiasm was rather short lived when we found that those patients who lost rapidly with pituitrin did just as well with a saline placebo [39] Apparently, those patients in our series who did well

did so because of the adherence to the diet, rather than because of any effect of the pituitrin

Sex Hormones

Both estrogens and testosterone have been suggested for the treatment of obesity While many women date the onset of their obesity to the menopause this does not mean that there is any causal relationship between obesity and cessation of ovarian function Estrogens cause retention of sodium and water hence a temporary gain in weight will ensue Testosterone will cause nitrogen retention Consequently, it has been advocated for use in the treatment of underweight It can hardly be expected that it is effective for both leanness and obesity

11 Oxycorticoids

From observations made during the past five years on approximately 30 obese patients there are two groups which will probably respond to treatment with a *rigidly observed diet* and an 11-oxycorticoid Here we must place those individuals with familial lipodystrophy and those who, because of ovarian dysfunction show a distribution of fat mainly to the lower abdomen hips thighs, and legs In both of these groups it is quite common to have the patient tell you that no matter how hard she tries to maintain a diet, the end result is always the same—loss of weight in the thinnest parts of the body with little, if any, change in the lower abdomen hips and legs These are the people who look thin and haggard about the face and neck following the loss of a few pounds but who never appear to rid themselves of weight below the waistline These people

will reduce quite satisfactorily when given a modest restriction of calories and an 11-oxycorticoid In fact, the diet should contain about 1500 *calories, which we apportion* somewhat as follows carbohydrates, 125 Gm , proteins, 85 Gm , and fat, 75 Gm

We have not been able to decide which of the 11 oxycorticoids *is* best for the purpose in hand Our experience is limited to the use of cortisone acetate and prednisone Our dosages have been 12 5 mg of the former four times daily or 5 mg of the latter twice or three times daily In *these doses,* there is no tendency for the appearance of side effects, provided the patient adheres strictly to the subcaloric diet Nor is it *necessary to give supplements* of potassium If the patient does not adhere to the diet, edema and acne are more commonly seen in those taking cortisone than in those using prednisone However, when the regimen is carefully followed, weight will disappear from all parts of the body This is least noticeable about the face, neck and upper torso which is directly in contrast to the former experiences *of this group of patients, who have always found* it impossible to remove any fat from the lower parts of the torso and lower extremities without excessive, unbecoming, and uncomfortable loss of weight from the waist up Again, it should be emphasized that this *relocation of fat* will not occur unless there is an over all reduction in weight Moreover, side effects from the corticoids are common in these types of obesity unless a subcaloric diet is eaten

CHAPTER 16

Management: Miscellaneous Medications, Physiotherapy, and Surgery

BULK

In order to prevent the sensation of hunger when low caloric diets are used, or as a substitute for food when no definite diet is prescribed, certain products, notably those containing methyl-cellulose, have been used. All these preparations have certain qualities in common. They are inert, have no food value, and expand in volume when moistened. Because of these properties, it is claimed that they give the patient a sensation of satiety and fullness without contributing any calories.

It is questionable as to whether methyl-cellulose has any effect on the stomach at all in the dosage usually employed (about 150 mg per tablet). Larger doses have a bulk laxative effect. In any case, it is not the stomach that controls the amount of food that is ingested, since denervation, and even total removal of the stomach have no lasting effect upon the intake of food.

Experimentally, it has been found that dilution of the diet of rats by the addition of an inert substance such as kaolin had no lasting effect upon their total caloric intake. These animals adjusted to this dilution by increasing the

amount of food ingested so as to maintain a constant caloric consumption [1]

The use of methyl cellulose is not completely without danger Although rare, cases of esophageal impaction and intestinal obstruction have been reported.

Vitamin Preparations

Vitamin C has been used to promote the elimination of fluid It has been used in the treatment of congestive cardiac failure Because of this property of ascorbic acid it has been incorporated into various types of reducing pills However, there are two important fallacies inherent in the rationale behind such preparations Firstly, large doses of ascorbic acid (in the region of 2 or 3 Gm a day) have been needed to demonstrate the diuretic action Such large doses are not nearly approximated in these widely advertised "reducing pills" Secondly, the treatment of obesity is concerned with a loss of fat not fluid

One of the vitamin C preparations was studied in the following experiment This product contained 30 mg of vitamin C skim milk powder, and dextrose, and allowed five and one half calories per tablet Patients were assigned in rotation to one of three groups All the patients were given an identical 1200 calorie diet Patients in group one were also given this vitamin C preparation Those in group two were given a placebo tablet, and those in group three received no medication of any kind The number of patients, the average duration of treatment, and average per cent overweight were similar for all three groups The average weekly weight loss for groups one and two was similar and slightly less than that attained by patients in group three The vitamin C preparation used in this study

was completely ineffective The results of this experiment are summarized in Table 12 [39]

TABLE 12 THE RATE OF LOSS OF WEIGHT OF THREE SIMILAR GROUPS OF PATIENTS EACH RECEIVING A 1000 CALORIE DIET AND ONE GROUP RECEIVING IN ADDITION, A VITAMIN C PREPARATION

	Group I	*Group II*	*Group III*
Medication	Vitamin C	Placebo	None
No of patients	15	17	17
Average time observed (wks)	4 6	4 8	4 4
Average loss of weight (lbs per wk)	0 4	0 5	0 7

BELLADONNA PREPARATIONS

Preparations of belladonna have been recommended for their effect in reducing gastric motility It is believed that by keeping food in the stomach longer, the desire for additional food is lessened While drugs of the belladonna group do diminish gastric motility, large doses are required to do so Other effects of the drug, such as mydriasis and dryness of the mouth, become manifest before there is any significant sedative effect on the stomach In any case appetite is not a local phenomenon of the stomach Vagotomy does not appreciably affect food intake Complete surgical denervation of the gastrointestinal tract in dogs does not cause anorexia For these reasons we cannot rationalize the use of belladonna and its derivatives in the management of obesity Finally, in our hands, its clinical application has been a failure

DEHYDRATION

Under this heading are included such therapies as diuretics, salt and water restriction purges, Turkish baths, and

amount of food ingested so as to maintain a constant caloric consumption [1]

The use of methyl cellulose is not completely without danger Although rare, cases of esophageal impaction and intestinal obstruction have been reported.

Vitamin Preparations

Vitamin C has been used to promote the elimination of fluid It has been used in the treatment of congestive cardiac failure Because of this property of ascorbic acid, it has been incorporated into various types of reducing pills However, there are two important fallacies inherent in the rationale behind such preparations Firstly, large doses of ascorbic acid (in the region of 2 or 3 Gm a day) have been needed to demonstrate the diuretic action Such large doses are not nearly approximated in these widely advertised "reducing pills" Secondly, the treatment of obesity is concerned with a loss of fat, not fluid

One of the vitamin C preparations was studied in the following experiment This product contained 30 mg of vitamin C, skim milk powder, and dextrose, and allowed five and one-half calories per tablet Patients were assigned in rotation to one of three groups All the patients were given an identical 1200 calorie diet Patients in group one were also given this vitamin C preparation Those in group two were given a placebo tablet, and those in group three received no medication of any kind The number of patients, the average duration of treatment, and average per cent overweight were similar for all three groups The average weekly weight loss for groups one and two was similar and slightly less than that attained by patients in group three The vitamin C preparation used in this study

was completely ineffective The results of this experiment are summarized in Table 12 [39]

TABLE 12 THE RATE OF LOSS OF WEIGHT OF THREE SIMILAR GROUPS OF PATIENTS EACH RECEIVING A 1000 CALORIE DIET AND ONE GROUP RECEIVING IN ADDITION A VITAMIN C PREPARATION

	Group I	*Group II*	*Group III*
Medication	Vitamin C	Placebo	None
No of patients	15	17	17
Average time observed (wks)	4 6	4 8	4 4
Average loss of weight (lbs per wk)	0 4	0 5	0 7

BELLADONNA PREPARATIONS

Preparations of belladonna have been recommended for their effect in reducing gastric motility It is believed that by keeping food in the stomach longer the desire for additional food is lessened While drugs of the belladonna group do diminish gastric motility, large doses are required to do so Other effects of the drug such as mydriasis and dryness of the mouth become manifest before there is any significant sedative effect on the stomach In any case appetite is not a local phenomenon of the stomach Vagotomy does not appreciably affect food intake Complete surgical denervation of the gastrointestinal tract in dogs does not cause anorexia For these reasons we cannot rationalize the use of belladonna and its derivatives in the management of obesity Finally in our hands its clinical application has been a failure

DEHYDRATION

Under this heading are included such therapies as diuretics salt and water restriction purges Turkish baths and

amount of food ingested so as to maintain a constant caloric consumption [1]

The use of methyl cellulose is not completely without danger Although rare, cases of esophageal impaction and intestinal obstruction have been reported

Vitamin Preparations

Vitamin C has been used to promote the elimination of fluid It has been used in the treatment of congestive cardiac failure Because of this property of ascorbic acid, it has been incorporated into various types of reducing pills However, there are two important fallacies inherent in the rationale behind such preparations Firstly, large doses of ascorbic acid (in the region of 2 or 3 Gm a day) have been needed to demonstrate the diuretic action Such large doses are not nearly approximated in these widely advertised "reducing pills" Secondly, the treatment of obesity is concerned with a loss of fat, not fluid

One of the vitamin C preparations was studied in the following experiment This product contained 30 mg of vitamin C, skim milk powder, and dextrose, and allowed five and one half calories per tablet Patients were assigned in rotation to one of three groups All the patients were given an identical 1200 calorie diet Patients in group one were also given this vitamin C preparation Those in group two were given a placebo tablet, and those in group three received no medication of any kind The number of patients, the average duration of treatment, and average per cent overweight were similar for all three groups The average weekly weight loss for groups one and two was similar and slightly less than that attained by patients in group three The vitamin C preparation used in this study

Massage

This is advocated to remove fat selectively from specified sites However, it has been demonstrated that massage of one limb will not change its size in comparison to the other nor will it mobilize enough fat to affect the concentration of blood lipids significantly [59]

On close examination, it will be found occasionally that the prominence of certain parts, especially the hip region, is not caused by an accumulation of fat but rather some peculiarity of bone structure such as a *flared* pelvis Diet, of course, cannot be expected to influence this

Sometimes adipose tissue accumulates in certain regions probably because of some hormonal influences which govern the site of fat deposition However, without an intake of food greater than the needs of the body, there can be no excess to be converted into fat Dietotherapy will frequently effect a removal of such localized fat deposits However in these cases, treatment should proceed cautiously lest fat be removed from other sites, such as the face and neck regions Frequent observation of the patient and repeated measurements are necessary in this type of case Treatment must be discontinued if the general appearance of the patient so indicates, as for instance, if she develops a gaunt, haggard look with lines in her face and neck

Surgery

Surgical removal of masses of fat is rarely done Aside from the hazards of surgery in obese individuals, with the risk of fat embolism and delayed healing, the basic cause of the obesity is not corrected Unless the dietary habits of

heat cabinets All these have one thing in common, the cause a loss of weight by eliminating water However, th loss is temporary, as the body will tend to remain in flu equilibrium It is the long-range change in weight that mus be observed, not day-to day changes While adipose tissu has an affinity for fluid, the amount of fluid cannot be to great, as any fluid retention in excess of 12 to 15 pounds results in manifest edema The average obese individual is no edematous What is desired is the elimination of fat, not water If excessive fat is eliminated, the fluid which was retained is also eliminated with it Elimination of fluid without the fat results in the rapid reaccumulation of the fluid

In addition to the ineffectiveness of dehydration, certain dangers exist with some forms of this therapy The most commonly used diuretics are ammonium chloride and the mercurials The prolonged use of ammonium chloride can result in a severe acidosis The mercurial diuretics are nephrotoxic Fatalities following their use have been reported Purging will completely derange the normal bowel habits of the individual Since most purges irritate the bowel, an irritative colitis can result

Combinations of Drugs

Many proprietary brands of reducing drugs are available For the most part, they consist of varying mixtures of several or all of the following amphetamine or methamphetamine, thyroid, cathartics, vitamins, belladonna, and a sedative Their individual actions have already been discussed There is no evidence that their action in combination is more adequate or effective than that obtained by use of the individual preparations

MASSAGE

This is advocated to remove fat selectively from specified sites However, it has been demonstrated that massage of one limb will not change its size in comparison to the other nor will it mobilize enough fat to affect the concentration of blood lipids significantly [59]

On close examination, it will be found occasionally that the prominence of certain parts, especially the hip region, is not caused by an accumulation of fat but rather some peculiarity of bone structure such as a *flared* pelvis Diet, of course, cannot be expected to influence this

Sometimes, adipose tissue accumulates in certain regions, probably because of some hormonal influences which govern the site of fat deposition However, without an intake of food greater than the needs of the body there can be no excess to be converted into fat Dietotherapy will frequently effect a removal of such localized fat deposits However, in these cases, treatment should proceed cautiously lest fat be removed from other sites, such as the face and neck regions Frequent observation of the patient and repeated measurements are necessary in this type of case Treatment must be discontinued if the general appearance of the patient so indicates, as for instance, if she develops a gaunt, haggard look with lines in her face and neck

SURGERY

Surgical removal of masses of fat is rarely done Aside from the hazards of surgery in obese individuals, with the risk of fat embolism and delayed healing, the basic cause of the obesity is not corrected Unless the dietary habits of

the patient are corrected the same factor that caused the obesity will continue to operate after the surgery, and the fat will reaccumulate

Surgical excision of redundant skin, such as a large abdominal apron, could be done after the weight has become stabilized by dietotherapy This is of value not only for cosmetic reasons but also to eliminate the severe dermatitis which develops on the adjacent surfaces of skin under such an apron

CHAPTER 17

Course and Follow-up

The Rate of Loss of Weight

THE RATE of loss of weight, as was discussed above, is not constant It is usually more rapid at the outset of the reducing regimen Plateaus occur during which time no weight is lost at all These sometimes last as long as two weeks and are caused by water and salt retention A spontaneous diuresis always follows The use of diuretics is not indicated However, patients should be told of these plateaus, lest their morale suffer because of a period of stationary weight even though they adhere to the diet Women should also be informed that no loss, or possibly even a slight gain of weight may occur immediately prior to menstruation, because of the retention of water Spontaneous diuresis with consequent satisfactory weight reduction occurs shortly after the onset of the period

Just as patients are not permitted to loaf and lose weight slowly and irregularly, they are dissuaded from losing weight too rapidly Some patients try to be heroic and lose weight rapidly by semistarvation Aside from the effects of malnutrition and vitamin deficiencies, cosmetically the end results are not too happy These patients frequently end up with unwanted lines in their faces, and a gaunt, haggard

expression For the first month of therapy, the patient is allowed to lose as much as he can After that, a maximum loss of eight to ten pounds a month is all that is permitted If necessary, dietary adjustments are made so that the maximum allowable monthly loss is not exceeded

Termination of Treatment

When can a satisfactory reduction of weight be considered accomplished? This is a difficult question to answer Theoretically, it can be stated that the patient should be reduced to his ideal weight However, ideal weights are difficult to determine Tables of desirable weights (see Chapter 1) are a useful guide and afford us an approximate ultimate goal The simplest answer to this question is to terminate active reduction when the patient looks and feels well Personal desires, within reason, must be respected Thus, a woman may want to stop reducing when she is about 8 to 10 per cent above the desirable level because that is the way her husband prefers her to look On the other hand, a model who had gained 60 pounds during a pregnancy required reduction to 10 to 15 per cent below her desirable weight before she could resume employment

After reduction has proceeded to desirable level, the patient must be told how this weight is to be maintained Fortunately, this is not difficult when the above regimen has been employed He is told to remain within three or four pounds of his weight at the time of discharge, thus giving him a six to eight pound leeway It is explained to him that were he to maintain the prescribed diet, he would continue to lose, and that such a decreased caloric intake could not support his desirable weight Consequently, he must increase his intake of food Using the prescribed diet as a

foundation, since it already allows him the essentials of a well balanced, mixed diet, he can increase the size of his portions, and add previously forbidden foods such as bread, butter, cream, and desserts in moderation He is told to weigh himself weekly and if he continues to lose, to increase his intake of food If his weight exceeds the maximum allowed him, he is to decrease his intake toward the original diet By a process of trial and error, the patient quickly learns what he can eat and yet maintain a desirable weight The transition from a hypocaloric to an isocaloric diet is made simply, quickly, and pleasantly He is urged to return should he have any problems, or should his weight begin to get out of hand

Return Visits

Regular and frequent return visits are important We have used various time intervals between appointments It was found that if too much time intervened between appointments, three or four weeks for example the patient would do as he pleased the first two weeks then try to lose all that was expected for the entire interval in the next week or two *It just did not work* At the clinic we have had to compromise our wishes with practicability and convenience and see our patients every two weeks Our private patients are seen weekly at the outset, and never less frequently than biweekly

At each return visit, after the weight has been recorded, the patient is encouraged to discuss any problem that may have arisen Even though the diet has been carefully explained at the initial visit, many questions regarding it invariably crop up once the patient actually starts living with it These are carefully answered

Minor modifications of the regimen may have to be made but these are kept to a minimum One of the most frequent allowances is a bedtime feeding Many people have become accustomed to a snack before retiring and they claim they cannot fall asleep without it They are advised to eliminate their desserts or milk at supper and eat or drink it at bed time

Unsatisfactory Loss of Weight

If the weight loss has been unsatisfactory the cause should be explored The patient is impressed with the fact that his failure to lose weight satisfactorily is caused by his straying from the prescribed diet and that every effort should be made to discover and correct these deviations

Many and varied are the excuses made by patients for their failure to lose weight Some will vehemently deny any dietary excesses but blame their failure on other factors Such excuses must be dealt with firmly It must be made clear to him that you cannot create something out of nothing It is extremely rare that an obese individual will maintain his weight or even gain weight on a submaintenance diet of less than 1500 calories It is like trying to run an automobile without gasoline Usually after firm refutation of such excuses the patient will sheepishly admit straying from the diet Such an admission is an important victory for the physician since it could bring about a complete change in the patient s concept of his disease

Other patients will frankly admit overeating but offer *excuses for so doing The usual excuses are* hunger and social obligations The problem of hunger is extremely important While he can be given some help to lighten this burden it usually cannot be eliminated completely It is

obvious that an individual who has been accustomed to eating excessively will not be completely satisfied with a drastically reduced intake of food However, it must be carefully explained to him that his discomfort will be temporary He should be told that his former eating habits were just that, habit Just as he developed faulty eating habits, he can educate himself to proper habits However, in order to do so, he must conscientiously adhere to the prescribed diet The patient who does well usually states after three to five weeks that he has no further difficulties or discomfort with the diet However, he must be willing to make this initial sacrifice Should he indulge his hunger, the results will be unsatisfactory on two counts he will not lose weight satisfactorily, nor will he ever become accustomed to a diminished intake of food

The individual who will not adhere to the diet because of social obligations must be impressed with the importance of the diet The analogy of diabetic patients is used frequently It should be explained that although the immediate effects of his dietary indiscretions are not as dramatic or serious as with a diabetic, the ultimate harm as regards his health and longevity is just as real

The Management of a Case

Although each patient must be treated as an individual, the general plan of management is fairly constant. At the first visit, a careful history is obtained It is important to know why treatment is being instituted Did the patient come for weight reduction, is a reducing regimen being recommended as an ancillary treatment for some other disease process, or is it prophylactic therapy in an otherwise healthy, normal individual? If either of the latter, the

reasons for weight reduction must be carefully explained The history should bring to light any unsuspected pathological process We routinely ask each patient why he became obese The patient who readily admits to eating excessively must be handled differently from the one who *eats like a bird* but has *gland troubles* The duration of obesity is important, especially as regards irreversible pathological changes Sometimes, valuable information regarding emotional conflicts is elicited while the history is being taken In this regard, we question the patient as to any factor which he feels caused him to start gaining weight A discussion of the patient's eating habits, although frequently unreliable, is important A menstrual and obstetrical history is taken in women

The physical examination is also performed carefully Evidences of vitamin deficiencies are sought Cardiovascular function is carefully evaluated Measurements, in addition to height and weight include span, lower measurements (pubis to floor), and the circumference at the neck chest waist, hips, and thighs In addition to the undressed weight the patient is weighed dressed without shoes, in order to have a comparison reference for future visits when it is not necessary to undress completely

Routine laboratory examinations include a complete urinalysis and blood count It is surprising how frequently an obese patient is anemic *Other tests are done only if* indicated We have found the basal metabolic rate to be abnormal so rarely as to dispense with this examination unless other findings suggest dysfunction of the thyroid gland [*40, 41, 42*] This examination however, may be necessary to convince an occasional patient that there really is nothing wrong with the function of his thyroid

The findings are then discussed with the patient Therapy for other pathological processes is prescribed The nature of obesity is explained to the patient He is made to under stand that fat can come only from the food he eats, and the only way fat can be eliminated is by regulation of his intake of food He is given a diet and instructions as to its use as described in Chapter 13 A suitable anorexigenic agent, usually one of the sympathomimetic amines, is prescribed However, the patient is impressed with the fact that he will not lose an ounce through the use of the drug itself, loss of weight will be brought about only by a decreased intake of food The anorexigenic drug will only make it easier for him to adhere to the prescribed diet He is instructed to return in one week

At subsequent visits, the weight is recorded, the blood pressure is checked, and he is again examined for evidences of vitamin deficiencies He is questioned regarding how he got along in the interim Changes in the regimen, as described above, are made if necessary If the loss of weight has not been satisfactory, reasons for this are sought The importance of the diet is continuously re emphasized The patient is seen weekly at least twice, and as many times thereafter as necessary until the physician feels that the patient is fully acquainted with the prescribed regimen and can follow it easily When this occurs, the patient is seen every second week After about two weeks the dose of the anorexigenic agent is gradually decreased, and is completely eliminated in three to five weeks The patient is seen at least every second week during the entire course of treatment Encouragement, praise, or reprimand is given as indicated After about fifteen pounds are lost, measurements at the above described sites are repeated It is excellent en-

couragement, and good for the patient's morale to be given objective evidence of a decrease in size These measurements are repeated regularly

When a desirable weight has been attained, the patient is advised how to maintain this weight by dietary changes as described above

TYPES OF PATIENTS AND THE RESULTS OBTAINED

Those with Strong Incentive

Since the patient's active participation in the treatment of obesity is necessary, the reason for his requesting treatment will materially influence the result We have observed several categories of patients where the incidence of therapeutic success is high These include girls of about 15 to 18 years of age who are just developing a social consciousness, but find themselves left out of things because of their appearance, single women in their early 30's (old enough to worry, but not old enough to have become reconciled to spinsterhood) who feel they are losing their chance for marriage, and men who cannot get insurance on standard terms

Children

We are extremely discouraged about our failure to obtain satisfactory results with young people For the most part they are themselves not interested in losing weight They *allow* treatment at either their parents' or physicians' insistence Even when it is at parental insistence, parental cooperation is not wholehearted Mothers frequently can't see that their child is obese because he eats too much, and feel they are starving' him by keeping him on even a liberal diet Also, the child, who isn't particularly interested in

losing weight, is not going to deprive himself of the candy, ice cream, and sodas that he usually gets outside the home between his meals

Others

Between these opposite groups is the large number of patients who must be convinced of the hazards of obesity Here the results of therapy will depend upon how well the physician can impress these upon *each patient* The average individual is not interested in obesity as an abstract term He must be made to understand the relationship between his excess weight and his arthritis, diabetes, or hypertension Even if no other abnormalities are found, the danger to his future health, and the potentially more rapid development of degenerative diseases, must be explained to him

Results Obtained in an Average Group

Recently, one of us has had the opportunity to observe a rather large group of patients under close supervision [39] The individuals in this group were employees at a large industrial organization, and could be considered comparable to the average patient seen in private practice

About half the group were comprised of individuals who were found to be obese on routine examination and for whom weight reduction was advised The remainder came in voluntarily for weight reduction Treatment was instituted on a total of 96 persons Of these, 16 are still under active treatment, 34 reduced to a desirable weight and were discharged, 44 discontinued treatment on their own (that is, did not return for further follow up), and 2 were dismissed [illegible] to cooperate Of the 44 who discon-
[illegible] within the first three weeks

couragement, and good for the patient's morale to be given objective evidence of a decrease in size These measurements are repeated regularly

When a desirable weight has been attained the patient is advised how to maintain this weight by dietary changes as described above

Types of Patients and the Results Obtained

Those with Strong Incentive

Since the patient's active participation in the treatment of obesity is necessary, the reason for his requesting treatment will materially influence the result We have observed several categories of patients where the incidence of therapeutic success is high These include girls of about 15 to 18 years of age who are just developing a social consciousness, but find themselves left out of things because of their appearance single women in their early 30's (old ough to worry but not old enough to have become conciled to spinsterhood) who feel they are losing their chance for marriage and men who cannot get insurance on standard terms

Children

We are extremely discouraged about our failure to obtain satisfactory results with young people For the most part they are themselves not interested in losing weight They *allow* treatment at either their parents' or physicians' insistence Even when it is at parental insistence, parental cooperation is not wholehearted Mothers frequently can t see that their child is obese because he eats too much and *feel* they are "starving" [illegible] by keep[illegible] him on even a liberal diet Also, the [illegible] ly interested in

losing weight, is not going to deprive himself of the candy, ice cream, and sodas that he usually gets outside the home between his meals

Others

Between these opposite groups is the large number of patients who must be convinced of the hazards of obesity Here the results of therapy will depend upon how well the physician can impress these upon each patient The average individual is not interested in obesity as an abstract term He must be made to understand the relationship between his excess weight and his arthritis, diabetes, or hypertension Even if no other abnormalities are found, the danger to his future health and the potentially more rapid development of degenerative diseases, must be explained to him

Results Obtained in an Average Group

Recently, one of us has had the opportunity to observe a rather large group of patients under close supervision [39] The individuals in this group were employees at a large industrial organization and could be considered comparable to the average patient seen in private practice

About half the group were comprised of individuals who were found to be obese on routine examination and for whom weight reduction was advised The remainder came in voluntarily for weight reduction Treatment was instituted on a total of 96 persons Of these, 16 are still under active treatment, 34 reduced to a desirable weight and were discharged, 44 discontinued treatment on their own (that is, did not return for further follow up), and 2 were dismissed for failure to cooperate Of the 44 who discontinued therapy, 18 did so within the first three weeks

ouragement, and good for the patient's morale to be given bjective evidence of a decrease in size These measure nents are repeated regularly

When a desirable weight has been attained the patient s advised how to maintain this weight by dietary changes s described above

Types of Patients and the Results Obtained

Those with Strong Incentive

Since the patient s active participation in the treatment f obesity is necessary, the reason for his requesting treat nent will materially influence the result We have ob erved several categories of patients where the incidence of therapeutic success is high. These include girls of about 5 to 18 years of age who are just developing a social con ciousness but find themselves left out of things because of heir appearance single women in their early 30s (old nough to worry but not old enough to have become econciled to spinsterhood) who feel they are losing their hance for marriage and men who cannot get insurance on tandard terms

Children

We are extremely discouraged about our failure to obtain atisfactory results with young people For the most part hey are themselves not interested in losing weight. They *llow* treatment at either their parents' or physicians in istence Even when it is at parental insistence parental co-operation is not wholehearted Mothers frequently can t see hat their child is obese because he eats too much, and feel hey are starving him by keeping him on even a liberal liet Also, the child, who isn t particularly interested in

losing weight, is not going to deprive himself of the candy, ice cream, and sodas that he usually gets outside the home between his meals

Others

Between these opposite groups is the large number of patients who must be convinced of the hazards of obesity Here the results of therapy will depend upon how well the physician can impress these upon each patient The average individual is not interested in obesity as an abstract term He must be made to understand the relationship between his excess weight and his arthritis diabetes, or hypertension Even if no other abnormalities are found, the danger to his future health and the potentially more rapid development of degenerative diseases must be explained to him

Results Obtained in an Average Group

Recently, one of us has had the opportunity to observe a rather large group of patients under close supervision [39] The individuals in this group were employees at a large industrial organization and could be considered comparable to the average patient seen in private practice

About half the group were comprised of individuals who were found to be obese on routine examination and for whom weight reduction was advised The remainder came in voluntarily for weight reduction Treatment was instituted on a total of 96 persons Of these, 16 are still under active treatment, 34 reduced to a desirable weight and were discharged, 44 discontinued treatment on their own (that is, did not return for further follow up), and 2 were dismissed for failure to cooperate Of the 44 who discontinued therapy, 18 did so within the first three weeks

couragement, and good for the patient's morale to be given objective evidence of a decrease in size These measurements are repeated regularly

When a desirable weight has been attained, the patient is advised how to maintain this weight by dietary changes as described above

TYPES OF PATIENTS AND THE RESULTS OBTAINED

Those with Strong Incentive

Since the patient's active participation in the treatment of obesity is necessary, the reason for his requesting treatment will materially influence the result We have observed several categories of patients where the incidence of therapeutic success is high These include girls of about 15 to 18 years of age who are just developing a social consciousness, but find themselves left out of things because of their appearance single women in their early 30's (old enough to worry, but not old enough to have become reconciled to spinsterhood) who feel they are losing their chance for marriage and men who cannot get insurance on standard terms

Children

We are extremely discouraged about our failure to obtain satisfactory results with young people For the most part they are themselves not interested in losing weight They allow treatment at either their parents' or physicians' insistence Even when it is at parental insistence, parental cooperation is not wholehearted Mothers frequently can't see that their child is obese because he eats too much, and feel they are "starving" him by keeping him on even a liberal diet Also, the child, who isn't particularly interested in

losing weight, is not going to deprive himself of the candy, ice cream, and sodas that he usually gets outside the home between his meals

Others

Between these opposite groups is the large number of patients who must be convinced of the hazards of obesity Here the results of therapy will depend upon how well the physician can impress these upon each patient The average individual is not interested in obesity as an abstract term He must be made to understand the relationship between his excess weight and his arthritis, diabetes, or hypertension Even if no other abnormalities are found, the danger to his future health, and the potentially more rapid development of degenerative diseases must be explained to him

Results Obtained in an Average Group

Recently, one of us has had the opportunity to observe a rather large group of patients under close supervision [39] The individuals in this group were employees at a large industrial organization, and could be considered comparable to the average patient seen in private practice

About half the group were comprised of individuals who were found to be obese on routine examination and for whom weight reduction was advised The remainder came in voluntarily for weight reduction Treatment was instituted on a total of 96 persons Of these, 16 are still under active treatment, 34 reduced to a desirable weight and were discharged, 44 discontinued treatment on their own (that is, did not return for further follow-up), and 2 were dismissed for failure to cooperate Of the 44 who discontinued therapy, 18 did so within the first three weeks

two patients The results of this analysis are summarized in Table 14

TABLE 14 EFFECT OF STATUS OF OBESITY (ACTIVE OR STATIC) UPON RESULTS OF TREATMENT

	Static	*Active*
Number	18	13
Time observed		
Range	3 24 wks	4 13 wks
Average	9 3 wks	7 6 wks
Total weight lost		
Range	10–64 lbs	10–50 lbs.
Average	22 5 lbs	18 lbs
Loss per week		
Range	1 7–4 2 lbs	1 0–4 0 lbs
Average	2 5 lbs	2 6 lbs
Time medication prescribed		
Range	1 8 wks	1–4 wks
Average	2 5 wks	2 5 wks

From the data recorded in this table, it can be concluded that in this study neither the method of therapy nor the results obtained were influenced by the status of the obesity of the individual patient

RESULTS OF SUCCESSFUL WEIGHT REDUCTION

The most obvious result of successful weight reduction is an improvement in appearance This gives a tremendous psychological *lift* to the patient J orale is improved, and his whole outlook on life is There is a n- creased feeling of well being ostered feeling of vict difficult

A lowerin ressur see loss of weig n of ratu obese hypert cardi to

breathlessness on mild exertion are relieved Cardiovascular disease complicated by congestive failure is no contraindication to reduction of weight On the contrary, removal of excess weight eliminates a considerable load from the already overworked, failing heart

Joint pains, particularly in the weight bearing joints as noted in osteoarthritis are frequent in overweight middle age individuals Removal of the excess weight almost invariably results in improvements in these arthritic manifestations

Intertrigo and hyperhidrosis are decreased and frequently completely eliminated by the removal of excess fat

Glucose tolerance is greatly increased when excess weight is lost The necessity for insulin can be eliminated in most obese patients whose diabetes started after the age of 40 Newburgh has suggested that glycosuria in the obese middle age individual is not true diabetes, but a result of fatty infiltration of the liver interfering with normal glycogen formation [83]

Menstrual disturbances such as irregularities and dysmenorrhea are frequently relieved or entirely eliminated when obesity is corrected Occasionally, sterility is corrected after weight loss However, so varied are the causes of sterility that this should not be promised a patient

A recent study has demonstrated that the serum concentration of high molecular lipoproteins considered by many to be concerned with development of atherosclerosis, is reduced after successful dietary treatment of obesity [120]

There is abundant evidence demonstrating that morbidity and mortality are increased in the overweight compared to those of normal weight A recent report by Dublin

two patients The results of this analysis are summarized in Table 14

TABLE 14 EFFECT OF STATUS OF OBESITY (ACTIVE OR STATIC) UPON RESULTS OF TREATMENT

	Static	*Active*
Number	18	13
Time observed		
Range	3 24 wks	4-13 wks
Average	9 3 wks	7 6 wks
Total weight lost		
Range	10-64 lbs	10-50 lbs
Average	22 5 lbs	18 lbs
Loss per week		
Range	1 7 4 2 lbs	1 0-4 0 lbs
Average	2 5 lbs	2 6 lbs
Time medication prescribed		
Range	1 8 wks	1-4 wks
Average	2 5 wks	2 5 wks

From the data recorded in this table, it can be concluded that in this study neither the method of therapy nor the results obtained were influenced by the status of the obesity of the individual patient

RESULTS OF SUCCESSFUL WEIGHT REDUCTION

The most obvious result of successful weight reduction is an improvement in appearance This gives a tremendous psychological *lift* to the patient His morale is improved, and his whole outlook on life is changed There is an increased feeling of well being This is also fostered by the feeling of victory over a difficult problem

A lowering of blood pressure is frequently seen after a loss of weight Reduction of weight is *imperative* in the obese hypertensive Other cardiovascular symptoms such as

Bibliography

1 ADOLPH C F *Urges to eat and drink in rats* *Am J Physiol* *151* 110 1947
2 ALBRECHT F K The use of Benzedrine Sulfate in obesity *Ann Int Med* *21* 983 1944
3 ANAND B K Hypothalamic control of obesity Food intake in rats and cats *Yale J Biol & Med* *24* 141 1951
4 ARMSTRONG D B DUBLIN L I WHEATLEY G M and MARKS H H Obesity and its relation to health and disease *J A M A* *147* 1007 1951
5 Association of Life Insurance Medical Directors and the Actuarial Society of America Medico-Actuarial Mortality Investigation Vol 1 1912 (New York)
6 BARKER N CHAIKOFF I L and SCHUNDEK A Effect of fructose in lipogenesis from lactate and acetate in diabetic liver *J Biol Chem* *194* 435 1952
7 BARKER N W NYGAARD K K WALTERS W and PRIESTLEY J T A statistical study of post operative venous thrombosis and pulmonary embolism II Predisposing factors *Proc Staff Meet Mayo Clin* *16* 1 1941
8 BEAUDOIN R VAN ITALLIE T B and MAYER J Carbohydrate metabolism in active and static human obesity *J Clin Nutrition* *1* 91 1953
9 BEHNKE A R Physiologic studies pertaining to deep sea diving and aviation especially in relation to the fat content and composition of the body Harvey Lecture Series (New York) 37 198 1941–2
10 BEYER K H and MEEK W J Effect of Benzedrine Sulfate on gastric emptying and intestinal activity *Arch Int Med* 63 752 1939
11 BLOCH K Interrelationships of lipid and carbohydrate metabolism *Ann Rev Biochem* *21* 273 1952
12 BOOTH G and STRANG J M Change in temperature of skin following ingestion of food *Arch Int Med* *57* 533 1936

indicates that a loss of the excess weight will correct this He studied the experience of the Metropolitan Life Insurance Company with persons accepted for insurance at a substandard rate solely because they were overweight, and who later lost their excess weight and reapplied either for reduction of their rating, or for new insurance A total of about 2300 persons were included in this study He found that among men in the lower substandard group who reduced, the number of deaths recorded was 113 per cent of the expected as compared with a ratio of 142 per cent of the expected in the entire experience from which they were originally drawn Among women, the ratio for those who reduced their weight was 90 per cent as compared with 142 per cent in the entire group For men in the higher sub standard group, who reduced their weight, the mortality ratio was only 109 per cent as compared with 179 per cent in the entire group from which they were drawn while among women, the ratios were 135 per cent and 161 re spectively [34]

While morbidity and mortality are higher in the overweight than in the population at large, correction of the obesity increases the life expectancy to normal. What stronger incentive to reduction can the abnormally fat person have! What more rewarding effort can he make! What goal in life affords the same degree of assurance! This is the optimistic note upon which the physician can always make his plea for the cooperation of the obese individual

31 DOUGLAS, H S Obesity The problem and treatment, *West J Surg, Obstet and Gyn* 59 238, 1951
32 DUBLIN, L I The influence of weight on certain causes of death, *Human Biol* 2 159, 1930
33 DUBLIN, L I, JIMINIS, A O, and MARKS, H H Factors in the selection of risks with a history of gall bladder disease, *Proc Assoc Life Ins Med Dir America* 21 34, 1934
34 DUBLIN, L I, and MARKS H H Mortality among insured overweights in recent years *Proc Assoc Life Ins Med Dir America* 4 1951
35 EVANS, F In *Diseases of Metabolism*, edited by Garfield Duncan, Philadelphia, W B Saunders Co 1942
36 FAUST, R A Complications of obesity, *New Orleans M & S J* 98 502, 1946
37 FENTON, P W, and CARR, C J The nutrition of the mouse Response of four strains to diets differing in fat content, *J Nutrition* 45 225, 1951
38 FREYBERG, H H, and NEWBURGH L H The obesity and energy exchange in a verified case of pituitary basophilism, *Arch Int Med* 58 229, 1936
39 GELVIN E P Unpublished data
40 GELVIN, E P, and McGAVACK T H Dexedrine and weight reduction *New York State J Med* 49 279 1949
41 GELVIN, E P, McGAVACK, T H, and KENIGSBERG S The anorexigenic effect of sustained release Dexedrine preparations *Am J Digest Dis* 20 307, 1953
42 GELVIN, E P, McGAVACK T H and KENIGSBERG, S Sustained release Dexedrine A comparison of various preparations in the management of obesity, *New York State J Med* 54 1340 1954
43 GELVIN, E P, McGAVACK T H, and KENIGSBERG S Observations on obesity Subjective impressions of 108 consecutive patients as to the causes of their obesity, *Am J Digest Dis* 20 200, 1953
44 GEORGE F BAKER CLINIC AND METROPOLITAN LIFE INS CO *Diabetes in the 1940's*, New York, Metropolitan Life Ins Co Press, 1940
45 GOLDZIEHER, M A Endocrine aspects of obesity, *Am J Digest Dis* 13 40, 1946
46 GRAFE, E *Metabolic Diseases and Their* delphia, Lea and Febiger, 1933
47 GURIN, S Lipogenesis *New*
48 GURNEY, R The hereditary 51 557, 1936

13 BRAM, I Therapeutic hyperthyroidism, *Internat Clin 1* 48, 1937
14 BROBECK J R Mechanism of the development of obesity in animals with hypothalamic lesions, *Physiol. Rev 26* 54, 1946
15 BROBECK J R Food intake as mechanism of temperature regulation, *Yale J Biol & Med 20* 545, 1948
16 BROBECK J R, TEPPERMAN, J and LONG, C N H Experimental hypothalamic hyperphagia in the albino rat *Yale J Biol & Med 15* 830 1943
17 BROOKS, C Mc A study of the respiratory quotient in experi
18
rat *Am J Physiol 147* 708 1946
19 BROOKS, C Mc, and LAMBERT E F A study of the effect of limitation of food intake and the method of feeding on the rate of weight gain during hypothalamic obesity in the albino rat, *Am J Physiol 147* 695, 1946
20 BROOKS, C Mc, LOCKWOOD R A, and WIGGINS, M L A study of the effect of hypothalamic lesions on the eating habits of the albino rat, *Am J Physiol 147* 735 1946
21 BROOKS, C Mc, MARINE, D N, and LAMBERT, E F A study of the food feces ratios and the oxygen consumption of albino rats during various phases of experimentally produced obesity, *Am J Physiol 147* 717 1946
22 BROZEK J, and KEYS, A Limitations of the "normal" body weight as a criterion of normality, *Science 112* 788, 1950
23 BRUCH, H Obesity in childhood I Physical growth and development of obese children *Am J Dis Child 58* 457, 1939
24 BRUCH H Obesity in childhood II Basal metabolism and serum cholesterol of obese children *Am J Dis Child 58* 1001, 1939
25 BRUCH H The Frohlich Syndrome Report of the original case *Am J Dis Child 58* 1282 1939
26 CARLSON, A J *The Control of Hunger in Health and Disease*, Chicago University of Chicago Press 1916
27 CECIL, R L *A Textbook of Medicine by American Authors* 6th ed, Philadelphia, W B Saunders Co, 1943
28 COLTON N H SEGAL H I STEINBERG, A, SCHECHTER, F R,
y with emphasis
29 ity, *Am J Med*
13 478, 1952
30 DAVIDOFF E and REIFENSTEIN, E E The stimulating action of Benzedrine Sulfate, *J A M A 108* 770 1937

hexoses, as studied by its effect on the distribution of galactose, *Am J Physiol 163* 70, 1950

67 LEVY, R L, WHITE, P D, STROUD, W D, and HILLMAN, C C Overweight Its prognostic significance in relation to hypertension and cardiovascular renal diseases *J A M A 131* 951, 1946

68 LUNBAEK, K, and STEVENSON, J A F Reduced carbohydrate intake after fat feeding in normal rats and rats with hypo thalamic hyperphagia *Am J Physiol 151* 530, 1947

69 MACKAY, E M, BARNES, R H, CAINE H O, and WICK, A N Ketogenic activity of acetic acid, *J Biol Chem 135* 157, 1940

70 MACKAY, E M, CALLAWAY J W, and BARNES R H Hyper alimentation in normal animals produced by protamine insulin *J Nutrition 20* 59, 1940

71 MACKAY, E M, and SHERRILL J W A comparison of the ke tosis developed during fasting by obese patients and normal subjects, *Endocrinology 21* 677, 1937

72 MACKAY, E M, WICK A N, and BARNUM, C P Ketogenic action of short chain even numbered carbon fatty acids in carbohydrate fed animals, *J Biol Chem 135* 183, 1940

73 MACKAY, E M, WICK A. N, and BARNUM C P Ketogenic action of odd numbered carbon fatty acids, *J Biol Chem 136* 503, 1940

74 MANKIN, H, STEVENSON, T R BROBECK, J R, LONG, C N H, and STETTIN, DEW JR The turnover of body fat in obesity resulting from hypothalamic injury studied with the aid of deu terium, *Endocrinology 47* 443, 1950

75 MASTER, A M, DUBLIN, L I, and MARKS, H H The normal blood pressure range and its clinical implications, *J A M A 143* 1464, 1950

76 MATTHEWS, H B, and DERBRUCKE, M G Normal expectancy in the extremely obese pregnant woman *J A M A 110* 554, 1938

77 MAYER, J Glucostatic mechanism of regulation of food intake, *New England J Med 249* 13, 1953

78 MAYER, J Genetic, traumatic and environmental factors in the etiology of obesity, *Physiol Rev 33* 472 1953

79 METROPOLITAN LIFE INS CO *Statistical Bulletin 24* 6, 1943

80 MILLER, N E, BAILEY, C J and STEVENSON, J A F Decreased "hunger" but increased food intake resulting from hypo thalmic lesion, *Science 112* 256, 1950

81 MIRSKI, A Metabolism of adipose tissue in vitro, *Biochem J 36* 232, 1942

49 HAGEDORN, H C, HOLTEN, C, and JOHANSEN, A H The pathology of metabolism in obesity, *Arch Int Med* *40* 30 1927

50 HARDY, J D, and DRABKIN, D L Measurement of body water, techniques and practical implications, *J A M A* *149* 1113, 1952

51 HARRIS, S C, IVY, A C, and SEARLE, L M The mechanism of amphetamine-induced loss of weight, *J A M A* *134* 1468, 1947

52 HERTIG, A T, and SOMMERS S C Genesis of endometrial carcinoma Summary of prior biopsies, *Cancer* *2* 946, 1949

53 HETHERINGTON, A W, and RANSON, S W Hypothalamic lesions and adiposity in rats, *Anat Rec* *78* 149 1940

54 HETHERINGTON, A W, and WEIL, A The lipoid calcium, phosphorus and iron content of rats with hypothalamic and hypophyseal damage *Endocrinology* *26* 723, 1940

55 HURTLEY, W H The four carbon atom acids of diabetic urine, *Quart J Med* *9* 301 1915–16

56 IVY, A C, and GOETZL F R *d* Desoxyphedrine, a review, *War Med* *3* 60 1943

57 JOHNSTON, M W SQUIRES, A H, and FARQUHARSON R F The effect of prolonged administration of thyroid *Ann Int Med* *35* 1008, 1951

58 [illegible]

59 KALB, S W The fallacy of massage in the treatment of obesity *J M Soc New Jersey* *41* 406, 1944

60 KEYS, A *Obesity measurement and the composition of the body* In *Overeating, Overweight and Obesity*, Nutrition Symposium Series No 6 New York, The National Vitamin Foundation, Inc, Jan 1953

61 KEYS, A *Handbook of Nutrition*, 2nd ed, Philadelphia The Blakiston Co 1951

62 KEYS, A, and BROZEK, J Body fat in adult man, *Physiol Rev* *33* 245, 1953

63 KNOOP, F Der abbau aromatischer fettsauren im tierkorper, *Beitr Chem Physiol Path* *6* 150 1904

64 LERAY, J *Considerations Actuelles sur les Obesites et leurs Traitements* 2nd ed, Paris, Libraire E LeFrancois, 1951

65 LEVIN, L., and FARBER, R K The endocrine mechanism controlling the mobilization of depot fat, *Tr New York Acad Sc* *3* 260, 1951

66 LEVINE, R, GOLDSTEIN, M S, HUDDLESTON, B, and KLEIN, S P *Action of insulin upon permeability of cells to free*

cator in the study of intermediary metabolism III The role of fat tissues, *J Biol Chem* 111 175, 1935

103 [illegible]

105 Stadie, W C, Zapp, J A, and Lukens, F P The effect of insulin upon the ketone metabolism of normal and diabetic cats, *J Biol Chem* 132 423, 1940

106 Stadie, W C, Zapp, J A, and Lukens, F P Intermediary metabolism in diabetes mellitus—The non formation of acetic acid and the ratio of ketone body increase to fatty acid decrease [illegible]

obes-

namic action of food in abnormal states of nutrition, *Am J M Sc* 182 49, 1931

109 Strang, J M, McCluggage, H B, and Brownlee, M A Metabolism in undernutrition Its change during treatment with high caloric diet, *Arch Int Med* 55 958, 1935

110 Strang, J M McCluggage H B, and Evans F A The nitrogen balance during dietary correction of obesity, *Am J M Sc* 181 336, 1931

111 Strang, J M, McCluggage, H B and Evans F A Further studies in the dietary correction of obesity, *Am J M Sc* 179 678, 1930

112 Strouse, S, and Dye M Studies on the metabolism of obesity I The relation between food intake and body weight in some obese persons, *Arch Int Med* 34 267, 1924

113 Strouse, S, Wang, C C, and Dye M Studies on the metabolism of obesity II Basal metabolism, *Arch Int Med* 34 275, 1924

114 Tainter, M L Actions of Benzedrine and Propadrine in the control of obesity, *J Nutrition* 27 89, 1944

115 Talbot, N B Obesity in children, *M Clin North America* 29 1217, 1945

116 Thompson, K J Some observations on the development and course of hypertensive vascular disease, Proc 3rd Annual Meeting Med Sect Am Life Convention 1950 [illegible]

82 NEWBURGH L H Control of hyperglycemia of obese diabetics by weight reduction *Ann Int Med 17* 935 1942
83 NEWBURGH L H and CONN J W A new interpretation of hyperglycemia in obese middle aged persons *J A M A 112* 7 1939
84 NEWBURGH L H and JOHNSTON M W The nature of obesity *J Clin Investigation* 8 197 1929
85 NEWBURGH L H and JOHNSTON M W Endogenous obesity a misconception *Ann Int Med 3* 815 1930
86 ODELL L D and MENGERT W F The overweight obstetric patient *J A M A 128* 87 1945
87 PAYNE R W Stud es on the fat mobilizing factor of the an terior pituitary gland *Endocrinology 45* 305 1949
88 PENNINGTON A W *Practical reducing regime* In "*Ot creat ing Overweight and Obesit j*" Nutrition Symposium Series No 6 New York The National Vitamin Foundation Inc Jan 1953
89 PENNINGTON A W A reorientation on obesity *New England J Med 248* 959 1953
90 PLOTZ C M KNOWLTON A I and RAGAN C The natural history of Cushing's syndrome *Am J Med 13* 597 1952
91 PLUMMER W A Body weight in spontaneous myxedema *Tr Am A Stud j Go ter* pp 88–98 1940
92 POPJAK G and BEEKMAN M L Extrahepatic lipid synthesis *B ochem J 47* 233 1950
93 PRICE W H CORI C F and COLOWICK, S P The effect of anterior pituitary extract and of insulin on the hexo kinase re-action *J Biol Chem 160* 633 1945
94 RAAB W The role of the posterior pituitary hormone in fat metabolism *Endocrinology 14* 6 1930
95 RABSON S M The fatty tissues Normal anatomy and changes
96
97
State J Med 54 6 1954
98 RONY H R *Obes ty and Leanness* Philadelph a Lea and Feb-iger 1940
99 RYNEARSON E H and GASTINEAU C W *Obes ty* Spring field Ill Cl as C Thomas Publisher 1949
100 SEWARD B P A clinical study of mild grades of hypothyro d ism *Ann Int Med* 9 178 1935
101 SHAPIRO B and WERTHEIMER E The synthesis of fatty acids in adipose tissue in vitro *J Biol Chem 173* 725 1948
102 SCHOENHEIMER R and RITTENBERG D Deuterium as an ind

Index

Acne from cortisone 112
Activity effects on body weight 56–57, 72 73–74
Addiction to amphetamine 105
Adenosine triphosphate activity 18
Adipose tissue 12–15
blood supply, 14
cell origin 12–13
innervation, 13–14
nature of stored fat 15
source of stored fat 15
Adolescent obesity 29
Adrenal factors in obesity 29–30 63
Adrenalectomy and fat mobilization 24
Adrenocortical factor in fat mobilization 24
Adrenotropic hormone and fat mobilization 24
Agranulocytosis from dinitrophenol 74
Ammonium chloride diuretics 116
d Amphetamine 100
weight loss from tables 98 99
Amphetamine preparations 96–105
addiction to 105
d amphetamine 100
methamphetamine 105
side effects of 103
Android type of obesity 27
Anorexia nervosa 69
Anorexigenic agents 96–108 125
d amphetamine 100
amphetamine preparations 96–105
clinical data table 102
comparative loss from table 101
Anorexigenic agents (*contd*)
methamphetamine 105–107
side effects of table 103
Anxiety overeating in 42
Appetite 33
Arthritis in obesity 131
Ascorbic acid 114
Atherosclerosis in obesity 8
ATP (adenosine triphosphate) 18

Basal metabolism 52–53
Belladonna preparations 115
Biedl Laurence Moon syndrome 31 68
Blood cholesterol levels of 68
glucose levels of and food intake 36
pressure increased in obesity 8
lowered after weight loss 130
supply to adipose tissue 14
Body components of 5
heat production 34 35
Buffalo obesity 63
Bulk in diet 113

Caloric allowances in diet 90
Calories excess intake of and weight gain 54
Carbohydrates adequate amount of 79
intermediary metabolism 18–21
tolerance decreased 64
Cardiovascular abnormalities in obesity 8
Castration and obesity 61
Cataracts from dinitrophenol 74

119 VanLiere, E J, and Sleeth, C K *The effect of Benzedrine* Sulfate on the emptying time of the human stomach, *J Pharmacol & Exp Therap* 6 111, 1938

120 Walker W J, Lowry, E Y, Love, D E, Mann, G V, Levine, S A, and Starr, F J Effect of weight reduction and caloric balance on serum lipoproteins and cholesterol level, *Am J Med* 14 654, 1953

121 Weil, R and Ross, S Growth hormone and fat metabolism, *Endocrinology* 45 207, 1949

122 Welham, W C, and Behnke, A R The specific gravity of healthy men—Body weight, volume and other physical characteristics of exceptional athletes and naval personnel, *J A M A* 118 498, 1942

123 Wells H G Adipose tissue, a neglected subject, *J A M A*. 114 2177, 2284 1940

124 Wertheimer E and Shapiro, B The physiology of adipose tissue *Physiol Rev* 28 451, 1948

125 Wilder R M The regulation of the weight of the body, *Internat Clin* (*Series* 42) *1* 31 1932

126 Wilder R M, and Wilbur, D L Progress in internal medicine diseases of metabolism, *Arch Int Med* 61 297, 1938

127 Wilens S L Bearing of general nutritional state on atherosclerosis *Arch Int Med* 79 129 1947

128 Wilhelmj C M The specific dynamic action of food, *Physiol Rev* 15 202 1935

129 [illegible]

130 [illegible]

131 Zelman, S The liver in obesity, *Arch Int Med* 90 141, 1952

Index

Acne from cortisone 112
Activity effects on body weight 56–57 72 73–74
Addiction to amphetamine 105
Adenosine triphosphate activity 18
Adipose tissue 12–15
  blood supply 14
  cell origin 12–13
  innervation 13–14
  nature of stored fat 15
  source of stored fat 15
Adolescent obesity 29
Adrenal factors in obesity 29–30 63
Adrenalectomy and fat mobilization 24
Adrenocortical factor in fat mobilization 24
Adrenotropic hormone and fat mobilization 24
Agranulocytosis from dinitrophenol 74
Ammonium chloride diuretics 116
d Amphetamine 100
  weight loss from tables 98 99
Amphetamine preparations 96–105
  addiction to 105
  d amphetamine 100
  methamphetamine 105
  side effects of 103
Android type of obesity 27
Anorexia nervosa 69
Anorexigenic agents 96–108 125
  d amphetamine 100
  amphetamine preparations 96–105
  clinical data table 102
  comparative loss from table 101
Anorexigenic agents (contd)
  methamphetamine 105–107
  side effects of table 103
Anxiety overeating in 42
Appetite 33
Arthritis in obesity 131
Ascorbic acid 114
Atherosclerosis in obesity 8
ATP (adenosine triphosphate) 18

Basal metabolism 52–53
Belladonna preparations 115
Biedl Laurence Moon syndrome 31 68
Blood cholesterol levels of 68
  glucose levels of and food intake 36
  pressure increased in obesity 8
    lowered after weight loss 130
  supply to adipose tissue 14
Body components of 5
  heat production 34 35
Buffalo obesity 63
Bulk in diet 113

Caloric allowances in diet 90
Calories excess intake of and weight gain 54
Carbohydrates adequate amount of 79
  intermediary metabolism 18–21
  tolerance decreased 64
Cardiovascular abnormalities in obesity 8
Castration and obesity 61
Cataracts from dinitrophenol 74

Cell origin of adipose tissue, 12–13
Cellulose in diet, 113
Childhood obesity, 67–68
  diet in, 93
  results of therapy, 126
Cholesterol levels, 68
Classification of obesity, 26–32
Climacterium and obesity, 61
Colitis, from purges, 116
Constipation from protein powder, 83
Contractions, stomach, 33
Cortisone, and fat metabolism, 24
  in obesity, 112
Course of weight reduction, 119–132
Cushing's syndrome, 30, 62, 63

Death rate in obesity, 11, 131
Definition of obesity, 1
Dehydration, 115–116
Densitometry and fat measurement, 5–6
Dercum's disease, 31
Dermatitis, 118
Desoxycorticosterone, and fat mobilization, 24
Desoxyephedrine, 105–107
Diabetes, glycolysis in, 23
  and obesity, 9, 64, 131
Diet, 78–95
  basic menus, 86–89
  bulk, 113
  caloric allowances, 90
  causing obesity, 47
  for children, 93
  food factors in basic 1000 calorie diet, 91
  functions of, 78
  high fat, 84–90
  high protein, 80–81
  instructions to patients, 93–95
  Pennington, 84
  planning, 78–80
  prescription for, 90–93
  protein powders, 82–84
  regulation of food intake, 33–37
  unnatural, 81
  vitamins, 114
Dilution test for fat measurements, 6
Dinitrophenol, and metabolic rate, 74
Diuretics, 29, 115
Drugs, 74–77
  combinations of, 116
Dynamic action of food, 53–55
Dysmenorrhea, and obesity, 131

Eating, mechanism of, 33
  overeating, 38, 42, 69, 122
Edema 112
Electrocardiography in obesity, 8
Emotional factors in overeating, 42, 69
Endocrine, factors in obesity, 28, 59–66
    adrenals, 63
    fat mobilization, 24
    gonads, 60–61
    pancreas, 64–65
    pituitary, 61–63
    thyroid, 59–60
  therapeutic preparations, 109–112
    cortisone acetate, 112
    estrogen, 111
    11 oxycorticoids, 111–112
    pituitary, 109, 110
    prednisone, 112
    sex hormones, 111
    testosterone, 111
    thyroid, 109
Endogenous obesity, 26
Energy, derivation of, 56
  expenditure, increased, 73–77
  intake, decreasing, 78–95
Environmental factors, 41
Estimation of body fat, 5
Estrogen therapy, 111
Etiology of obesity, 38–66
  basal metabolic rate, 52–53
  dietary factors, 47
  digestion and absorption, 50
  dynamic action of foods, 53–55
  endocrine factors, 28, 59–66
  environmental factors, 41
  glandular dyscrasia, 26
  gonads, 60–61

Etiology of obesity (*contd*)
hereditary factors 28 39–42 111
hypothalamus 43–47
ketosis 55–56
lipophilia 57–58
luxury consumption 55
metabolic factors 48–58
nervous factors 43
nitrogen exchange 50
pancreas 64–65
physical activity 56–57
pituitary 61–63
psychological factors 42 69
rebound of metabolism 55
respiratory quotient 50–52
thyroid 59–60
Exercise 73–74
effects on weight 56–57 72
Exogenous obesity 26

Familial lipodystrophy 31 111
obesity 28 39–42
Fasting, glycolysis in 23
Fat diet high 84–90
embolism from surgery 117
estimation of 5–7
chemical analysis 5
clinical evaluation 7
densitometry 5–6
dilution tests 6
skinfold measurements 5
intermediary metabolism 16–17
mobilization 24–25
relocation, 112
Fluid and salt intake 94 115
Follicle stimulating hormones and fat mobilization 24
Follow up of obesity 119–132
Food intake regulation 33–37
glucostatic mechanism theory 35–37
hunger and appetite 33
mechanisms 34
thermostatic mechanism theory 34–35
Freudian concept, 42
Frohlich s syndrome 29 31 61
treatment, 110
Frustration overeating in 42

Gallbladder disease in obesity 9
Gastric irritation from protein powder 83
Gastrointestinal disorders from d amphetamine 102
Glandular dyscrasia causing obes ty 26
Glucagon 64
Glucose blood levels of and food intake 36
metabolism 18
and nervous system activity 36
shunt 21
tolerance increased after weight loss 131
Glucostatic mechanism theory 35–37
Glycolysis acceleration 23
Glycosuria 46 65
Gold thioglucose obes ty 27
Gonads 60–61
Growth of fat tissue 13
hormones and fat mobilization 24
Gynoid obesity 27

Habit obes ty 28 32 69
Hazards of obesity 8–11 131
morbidity 8–11
mortality 11 131
Heat body product on of in obesity 34
in thin persons 35
cabinets 116
Height weight tables 1–5
Hereditary lipodystrophy 31 111
obesity 27 39–42
Hexokinase activity rate 24
Hexosemonophosphate shunt 20–21
Hormones *See* Endocrines
Hunger 33 122
Hurtley hypothesis of fatty acid metabolism 16
Hyperglycem c syndrome of mice 40 57 64
Hyperhidrosis in obesity 131
Hyperinsulinism 65
Hyperphagia 43 46

Hypertension in obesity 8
Hypoinsulinism 65
Hypothalamic obesity 27 *28* 29 43–47
Hypothalamus temperature sensitive cells in 35
Hypothyroidism and obesity 30 59 74

Inactivity and food intake 57
Incidence of obesity 7
Innervation of adipose tissue 13–14
Insomnia from *d* amphetamine 102
Insulin 64
  effects on hexokinase activity 24
  elimination of after weight loss 131
  hyperinsulinism 65
  hypoinsulinism 65
  requirements for fat storage 45
Intertrigo in obesity 131

Kaolin in diet 113
Ketone bodies 16
Ketonemia and fat mobilization 84
Ketosis 18 55–56
Knoop β oxidation theory 16

Laboratory examinations 124
Lactogenic hormones and fat mobilization 24
Laurence Moon Biedl syndrome 31 68
Lipid and carbohydrate metabolism 18
Lipodystrophy familial 31 111
Lipogenesis 16 22–24
Lipophilia 57–58
Loss of weight *See* Weight loss
Luteinizing hormones and fat mobilization 24
Luxury consumption 55

MacKay theory of fatty acid metabolism 17
Management of obesity 69–118 123–126
  amphetamine preparations 96–105

Management of obesity (*contd*)
  anorexigenic agents 96–108
  belladonna preparations 115
  bulk 113
  in childhood 93 126
  decreasing energy intake 78–95
  dehydration 115–116
  diet 78–95
    See also Diet
  dinitrophenol 74
  drugs 74–77
  endocrine preparations 109–112
  exercise 73–74
  general considerations 69
  hormones 109
  increasing energy expenditure 73–77
  massage 117
  methamphetamine 105–107
  11-oxycorticoids 111
  physician s role 70–72
  physiotherapy 117
  pituitary therapy 109 110
  protein powders *82*
  psychological factors in 69–70
  results 126–132
    See also Results of therapy
  sex hormones 111
  successful results 130–132
  surgery 117
  termination of therapy *120*
  thyroid therapy 109
  vitamin preparations *114*
Massage 117
Mayer's glucostatic mechanism theory 35
Measurement of obesity 1–5
  fat content percentage *5*
  frame distinction 2
  height weight tables *1–5*
Men height weight table 3
Menarche in obese girls *68*
Menopause weight changes in 31 61 111
Menstrual disorders and obesity 61 68 131
Mental retardation and obesity 68
Menus basic 86–89
  See also Diet

INDEX

Mercurial diuretics 116
Mesencephalic-pituitary system disturbances 63
Metabolism 48–58
basal 52–53
carbohydrate 18–21
digestion and absorption 50
dynamic action of foods 53–55
ts 16–17
etosis 55–56
popbulia 57–58
uxury consumption 55
nitrogen exchange 50
pathways table 19
physical activity 56–57
rebound of 55
respiratory quotient 50–52
Methamphetamine 105–107
side effects 106 107
Methyl cellulose in diet 113 114
Middle age spread 31
Minerals adequate amount of 79
Moon Biedl Laurence syndrome 31 63
Morbidity with obesity 8–11 131
Morgagni Morel syndrome 31
Mortality in obesity 11 131
tables 9 10
Mouth dryness from belladonna 115
Mydriasis from belladonna 115
Myxedema and obesity 30 60 74

Nausea from protein powder 83
Nerves in fat tissue 13–14
Nervous obesity 28 29
Nervous system glucose activity in 36
Nervousness from d amphetamine 102
Neuritis from dinitrophenol 74
Nitrogen exchange 50
Nutrition See Diet

Obstetrical complications in obesity 10
Osteoarthritis in obesity 10 131
Ovarian obesity 30 111
Overeating, 38 42 69
Overeating (contd)
during therapy 122
Oxaloacetate formation 18
Oxidation mechanism in fat metabolism 16
β Oxidation theory of Knoop 16
Oxycorticoids 111–112
11 Oxycorticoids 111–112

Pancreas activity 64
Pennington diet 84
Physical activity 56–57 73
examination 124
Physician s role 70–72
Pituitary factors in obesity 31 61–63
hormones and fat mobilization 24
therapy with 109 110
and mesencephalic system disturbances 63
Pituitrin 63
Potassium 112
Prednisone therapy 112
Pregnancy 10 61
Prescription of diet 90–93
Protamine zinc insulin 64
Protein adequate amount of 79
diet high 80–81
powders 82–84
Pseudoobesity 63
Psychiatric therapy 70
Psychological factors 42 69–70
Puberty weight changes in 61
Purges 115
Pyruvate activity in metabolism 18
Pyruvic acid inhibitory effect of 84

Reduction of weight. See Weight loss
Relocation of fat 112
Respiratory quotient, 50–52
in animals 44
Results of therapy 126–132
average patients 127–130
children 126
patients with strong incentive 126
successful weight reduction 130

Results of therapy (*contd*)
tables 128 130
Return visits 71 121

Salt and fl uid intake 94 115
Sex hormones 111
Simmond s disease 62
treatment 109
Skin rashes from dinitrophenol 74
temperature after eating 34
Skinfold measurement of fat 5
Source of excess fat 38
Specific dynam c action 34 53
Stadie theory 17
Sterility and obesity 61
Stewart Morel Morgangi syndrome 31
Stomach contractions of 33
irritation from protein powder 83
Stored fat nature and source of 15
Surgery 117
Synthesis of fat 15

Temperature environmental and weight gain 35
skin after eating 34
Termination of treatment 120
Testosterone therapy 111
Thermostatic mechanism theory 34–35
Thiouracil and fat metabolism 24
and food intake decrease 35
Thyroid gland factors in obesity 59–60
hormone therapy 74 109
calorigenic effect 75

Thyroid hormone therapy (*contd*)
tolerance to 76
toxicity 75
Thyroidectomy and fat mobilization 24
and food intake decrease 35
Thyrotropic hormone and fat mobilization 24
Thyroxine and fat mobilization 24
and food intake increase 35
Treatment *See* Management of obesity
Turkish baths 115
Types of obesity 23
of patients 126

Vagotomy food intake after 115
Vitamins adequate amount of 79
defic encies 124 125
preparations 114

Water restrictions 115
retention 29
Weight average 1
desirable for adults 3
and height tables 1–5
loss 95 119
average weekly rate 129
caloric diet *vs* protein powder 82
d et and vitamin C, 115
methamphetamine *vs* placebo 106
unsatisfactory 122
optimum 1
Women height we ght table for 3